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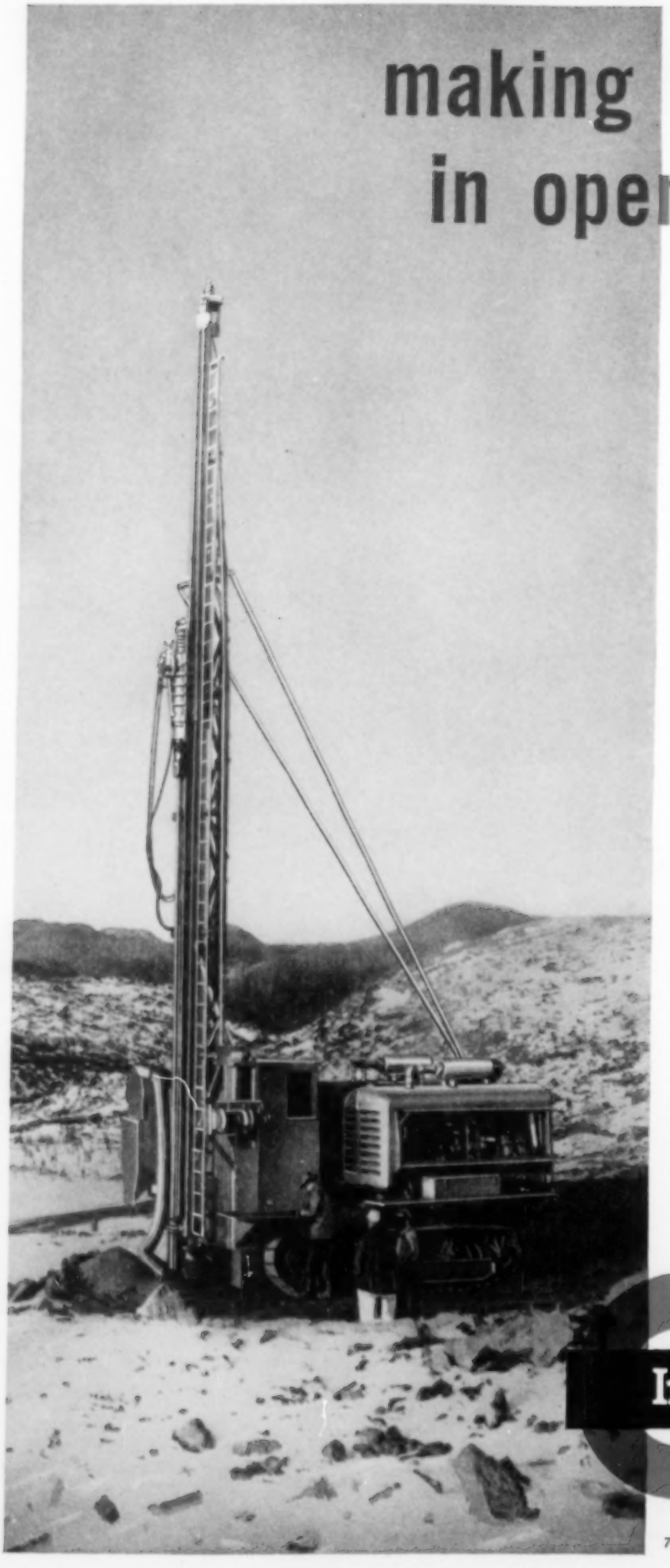
PHOTO, AMERICAN FRUIT GROWER MAGAZINE

MECHANIZED WAR WITH CHEMICALS

Apple growers spray toxic mist to combat orchard enemies

VOLUME 57 • NUMBER 5

NEW YORK • LONDON



making big savings in open-pit mining

The I-R QUARRYMASTER

cuts the cost of primary blast-hole drilling in any kind of ore

HIGH drilling speed, low bit cost, minimum labor requirements, low service truck charges—these are but a few QUARRYMASTER advantages that give you the lowest possible drilling cost per ton. Fast drilling speeds mean more holes per day, permitting closer hole spacing for better fragmentation. The result is increased primary crusher efficiencies and reduced costs on loading and hauling equipment. Compare these features with any other drill rig.

- DRILL ANY KIND OF ROCK—from the softest limestones and dolomites to the hardest granites.
- REAL DRILLING SPEED—drills 25 to 60 feet per hour in limestone and 9 to 15 feet per hour in granite.
- LOWEST BIT COST—of any blast hole drilling method. Carset Bit life from 700 to 1600 feet in granite—up to 14,000 feet in soft, less abrasive formations.
- NEEDS NO BLACKSMITH SHOP—Carset Bits are easily handled and sharpened on the job. No falling off of drilling speeds because of dull bits.
- REQUIRES NO SPECIALIZED LABOR.

Ask your nearest Ingersoll-Rand representative about this completely self-contained, self-propelled outfit that drills 6-inch holes, has continuous hole cleaning, automatic rotation and is available in either diesel or electric drive.

INGERSOLL-RAND COMPANY
11 Broadway, New York 4, New York

Ingersoll-Rand
QUARRYMASTER

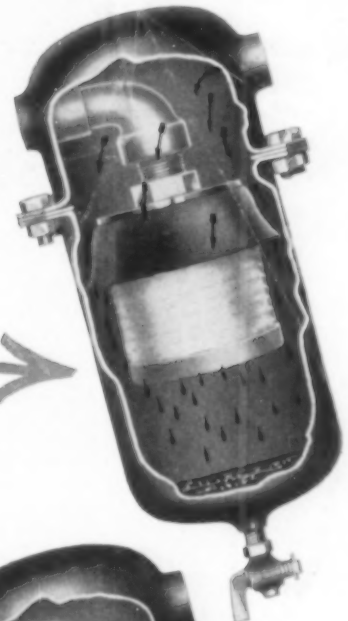
711-S

STAYNEW FILTERS' DOUBLE ACTION

Guards Against Water, Oil and Pipe Scale

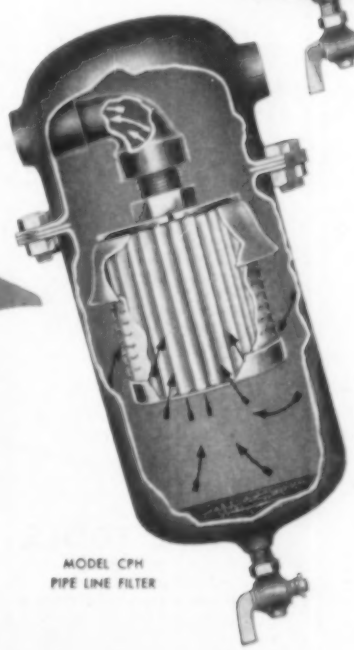
MECHANICAL SEPARATION

1. Deflector cup directs flow of air or gas together with water, oil and dirt to the walls of the housing and then downward at high velocity into the base where liquid and heavier dirt particles are deposited.



FILTRATION

2. Air or gas, having been mechanically cleaned, rises at low velocity through the Radial Finned Filtering element or insert which removes the lighter air-borne material.



MODEL CPH
PIPE LINE FILTER

This exclusive Double-Action principle of Staynew Pipe Line Filters assures sustained, trouble-free operation. Inexpensive, quickly installed and easily maintained, these filters keep air operated or controlled equipment free from pipe scale, dust, dirt, and condensate. Wherever you require air and other gases *clean* and *dry*—demand and get—Staynew Pipe Line Filters.

Write today for complete Staynew Pipe Line Filter Bulletin B-1A.

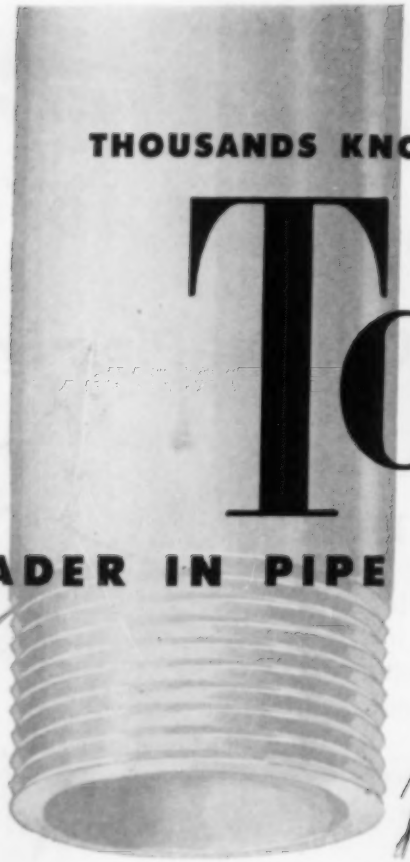
Representatives in Principal Cities

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

DOLLINGER CORPORATION

7 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED



THOUSANDS KNOW IT PAYS TO RELY ON

Toledo

LEADER IN PIPE TOOLS FOR *50* YEARS

Toledo leadership started a revolution in pipe tools 50 years ago...inventing easy-threading tools with receding die segments instead of solid dies.

You've heard it said, "There's no substitute for experience"—and this has a two-way meaning to countless thousands of mechanics who are long-time users of Toledo Pipe Tools.

Experience of the man on the job has shown that Toledos are tools he can trust! Easy handling . . . accurate threading . . . time-saving . . . high production tools that produce *leak-proof joints* and *reduce costs!*

50 years of experience at the Toledo factory keeps the entire line of Toledo Pipe Tools, Power Pipe Machines and Power Drives *steadily improved* . . . always out-front in performance and dependability. May we send you our 50th Anniversary Brochure telling how pipe tools can serve you better? Write . . . The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

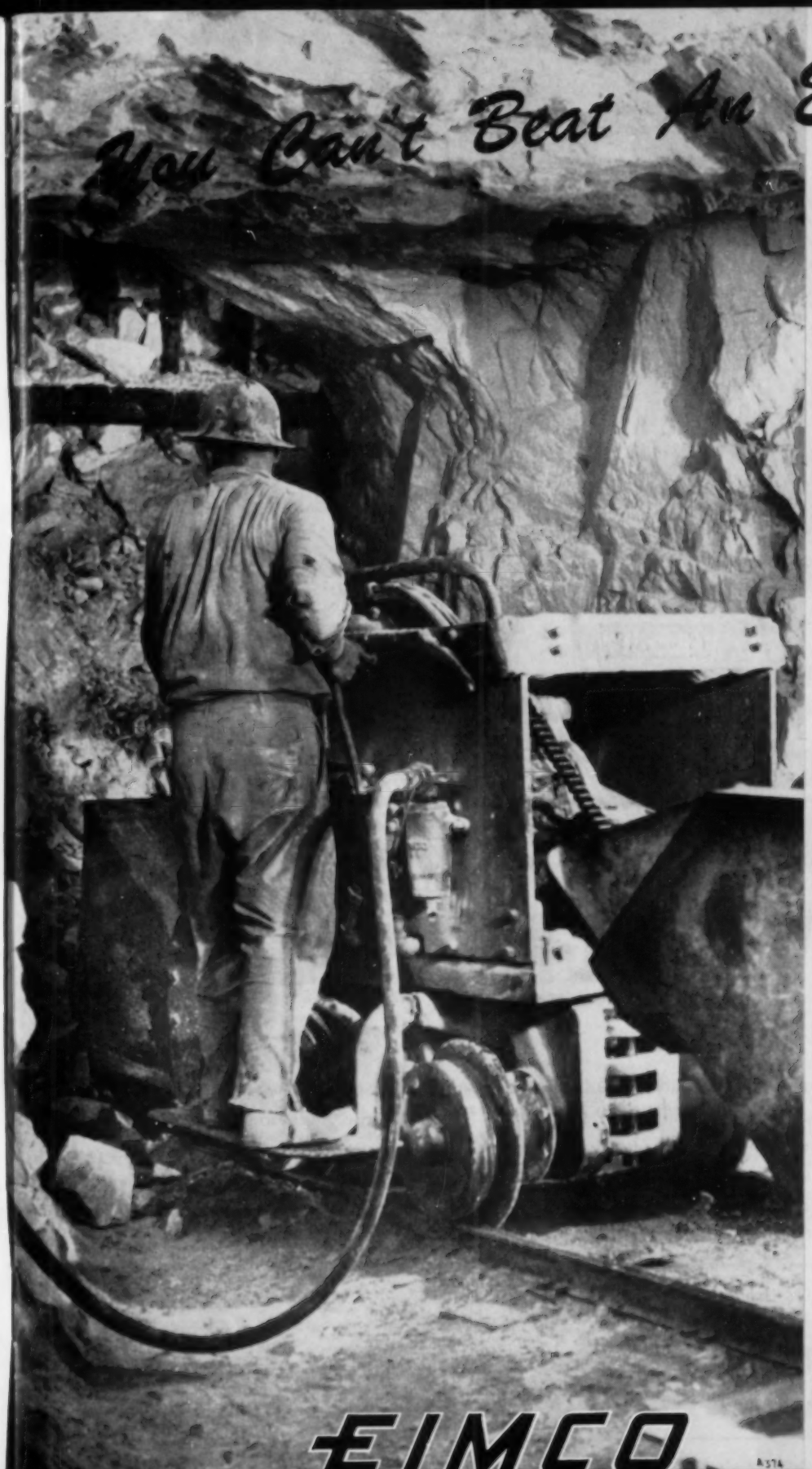
TOLEDO

PIPE TOOLS . . . POWER PIPE MACHINES . . . POWER DRIVES

Factory and General Offices at Toledo.

Toledo Simpact, 1" to 2" threader.

Toledo No. 999 2" Power Pipe Machine.

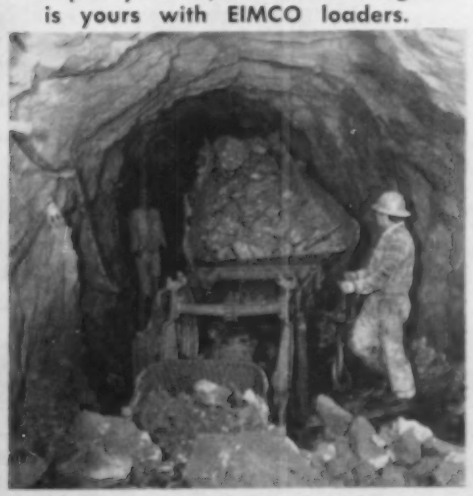


You Can't Beat An Eimco

The tougher the job the more essential it is that you load with an EIMCO. Loading underground needs the dependability of

equipment that can stand up to the unexpected and keep right on working. On contract jobs you need the speed that EIMCO equipment provides even on "under par" air pressures. On

long high-speed tunnels you need the flexibility of EIMCO equipment to load big cars to capacity. Safe, low-cost loading is yours with EIMCO loaders.



There is an EIMCO for every loading job.

EIMCO

A-374

THE EIMCO CORPORATION

The Leader in the Manufacture of Vacuum Filtration Equipment

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

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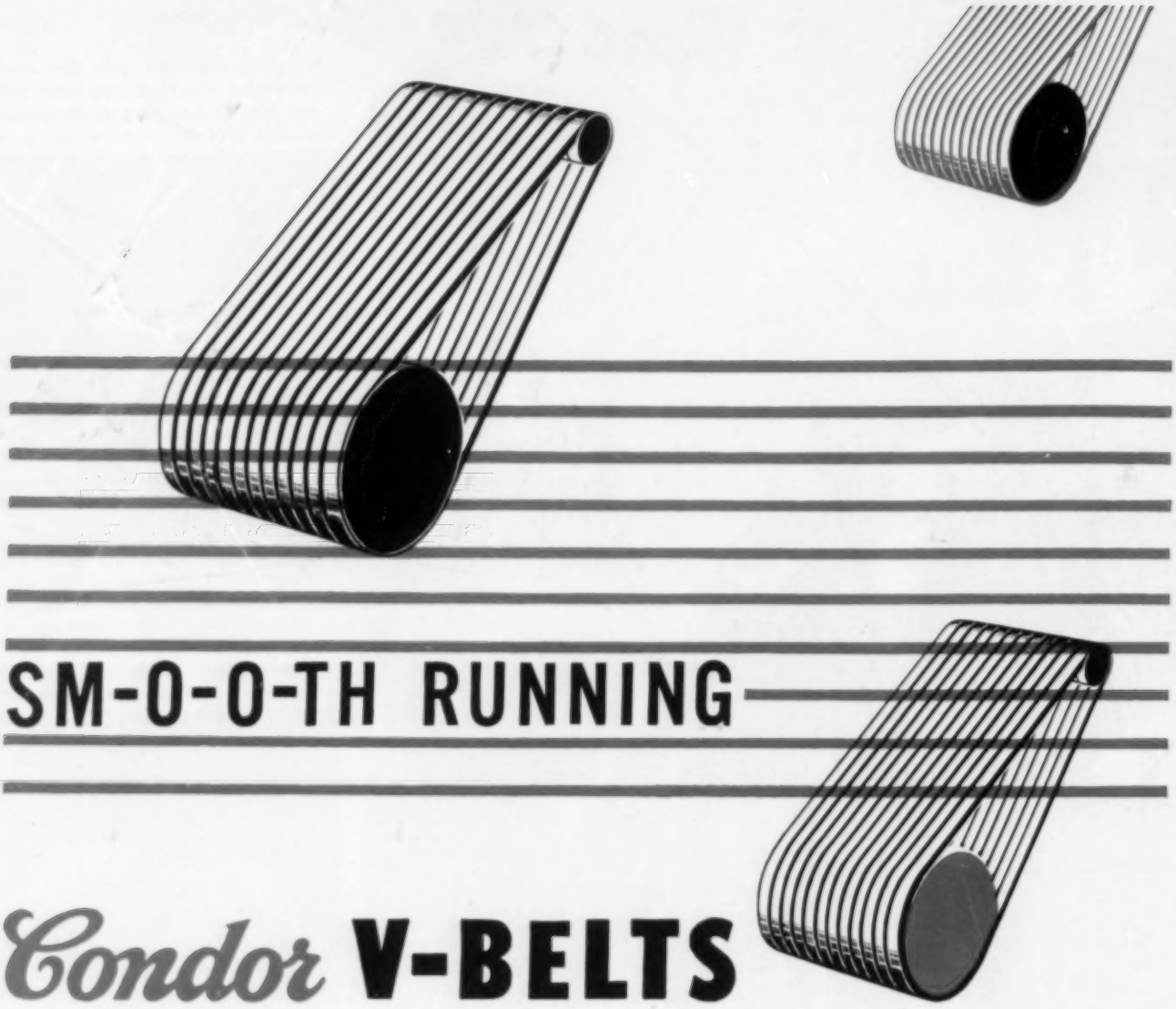
IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD



SM-O-O-TH RUNNING

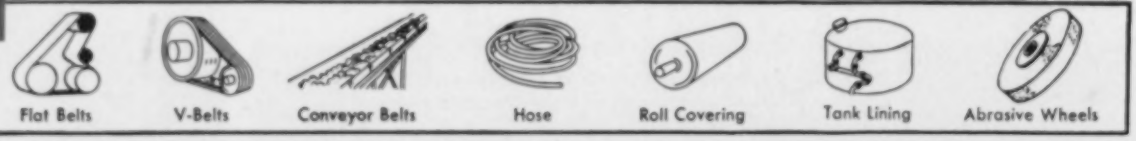
Condor V-BELTS

You get long belt life and low belt costs with Condor V-Belts because they are the smoothest running V-belts made. These are the Raybestos-Manhattan engineering reasons . . . Pulling section is micro-positioned, where engineering says it should be . . . Straight sidewalls give more grip, less slip, longer life . . . Every part of belt is precision-balanced. Other advantages are described in Bulletin 6868D. Write for a copy . . . or call your R/M Distributor • We can show you also how equally good engineering in R/M hose, conveyor and transmission belts helps "smooth out" production problems.

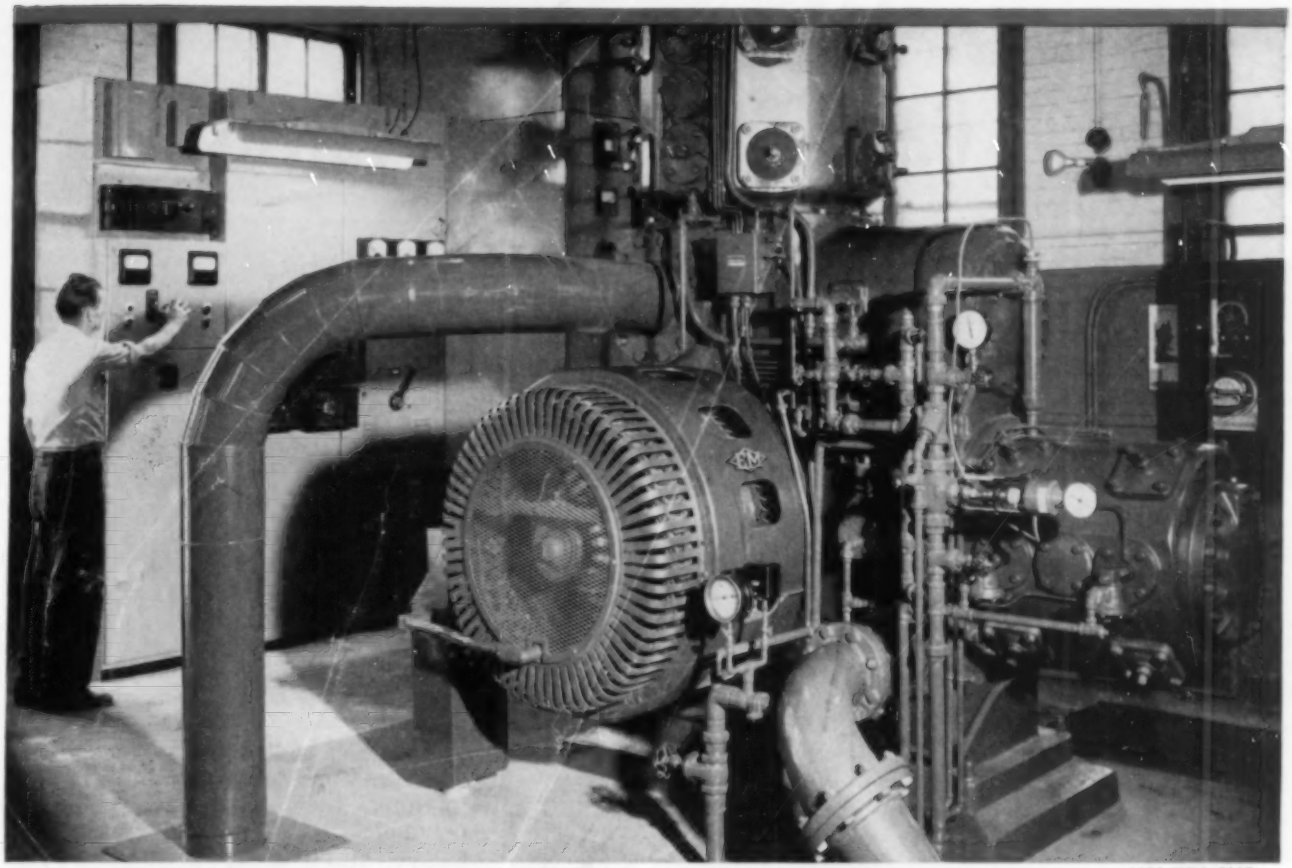
R/M

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Packings • Brake Linings • Brake Blocks Clutch Facings • Asbestos Textiles • Sintered Metal Parts • Bowling Balls



1100-TPA-2115

How to Make Compressors Take up Less Space

Want to save some valuable floor space?

Here's how it is done on the air compressor drive installation above:

The compressor is driven by a 200 hp, 514 rpm E-M Synchronous Motor, overhung mounted. Stator and rotor are mounted directly on compressor frame and crankshaft. Motor bearings as well as losses from belt drives and couplings are eliminated. The drive motor thus becomes a compact, integral part of the entire compressor unit.

You'll save space on any compressor with a direct-connected E-M Synchronous Motor. E-M engineers possess a unique background of experience in tailoring Synchronous Motor characteristics to drive requirements of every type of compressor. This skill, plus E-M's knack for condensing drive units into least possible space, should be considered when you plan your next compressor installation.

Also, you'll find that E-M Synchronous Motors can improve plant power factor and reduce power costs. For example, an E-M Motor rated at 0.8 leading power factor will furnish sufficient leading reactive KVA to correct a low power factor condition which may be caused by demands of other plant equipment.

Ask your nearest E-M sales engineer to demonstrate how these E-M benefits can be applied to your specific requirements. And write the factory for E-M Synchronizer No. 32, the air compressor number.

...the man at the controls

starts, stops and protects the motor with E-M special feature Controls ... magnetic, for automatic operation ... full-voltage, for economical starting ... dead-front panels for maximum safety ... overload and undervoltage protection ... and the exclusive E-M Polarized Field Frequency Relay system, simplest and most ingenious method ever developed for perfect synchronizing.

ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA

E-M

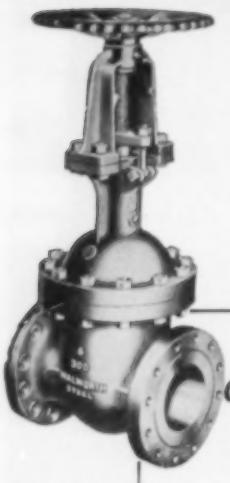
POWER THAT THINKS...E-M SYNCHRONOUS MOTORS AND "CONSCIOUS" CONTROLS

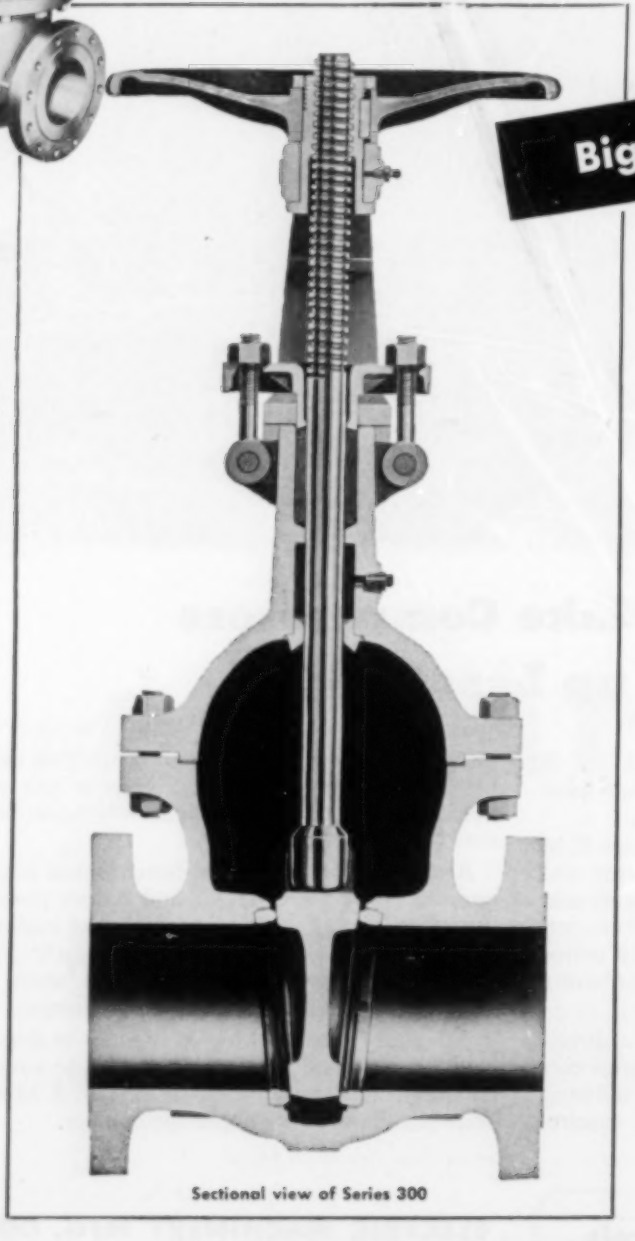
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

TALC MINED IN NEW YORK IS GROUND SO FINE YOU CAN'T EVEN SEE IT

Aerial view shows the surface buildings of the Gouverneur Talc Co. near Balmat, N. Y. The mine headframe is at the left; at the far right are the milling plant and silos for storing ore and ground talc.

A talc particle of 0.8 micron diameter would have to be enlarged 55 times before it would be visible to the average eye! That's the kind of superfine talc they grind at the plant of Gouverneur Talc Company, Inc., near Balmat, N. Y., in the heart of the Empire State's talc-mining district.

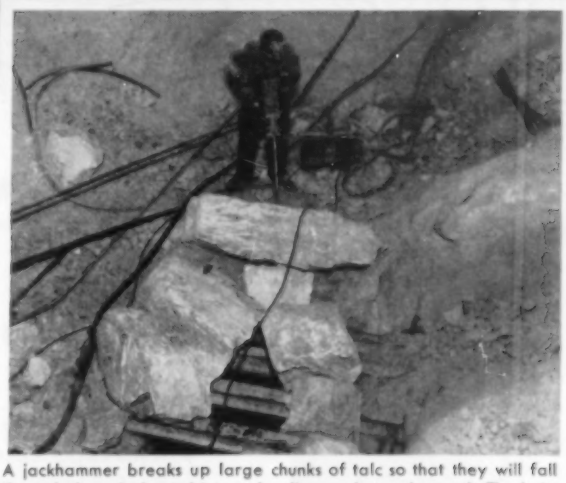
Besides conventional grinding mills for talc of medium to large particle size, there are fluid-energy mills for the superfine sizes. The grinding energy is supplied by heated compressed air at high velocities which agitates the talc particles so furiously that they are broken down into the desired small sizes by being bombarded against each other at terrific speeds.

In operation since 1948, this producer, a subsidiary of R. T. Vanderbilt Co., of New York, has become a leading source of talc for use in paint, ceramics, cosmetics, paper, and many other products. Present output is about 200 tons daily. Using a modified room-and-pillar method, rooms are mined out from the dipping veins so that enough ore is left to serve as pillars for supporting the roof. The mine workings include a 600-ft vertical shaft, lined with concrete and having three compartments. Main operating levels are at depths of 300 and 500 ft.

Both jackhammer and stoper drills are used in production and development work, holes being bored 6 to 8 ft deep. Like so many mining men, they rely principally on Bethlehem Hollow Drill Steel. About 1200 ft per day is drilled, using both conventional detachable bits and carbide-tipped bits. Rods are reconditioned in the mine's own blacksmith shop.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



A jackhammer breaks up large chunks of talc so that they will fall through the grizzly and into a loading pocket underneath. The hoist near the drill operator is used to scrape ore to the grizzly.

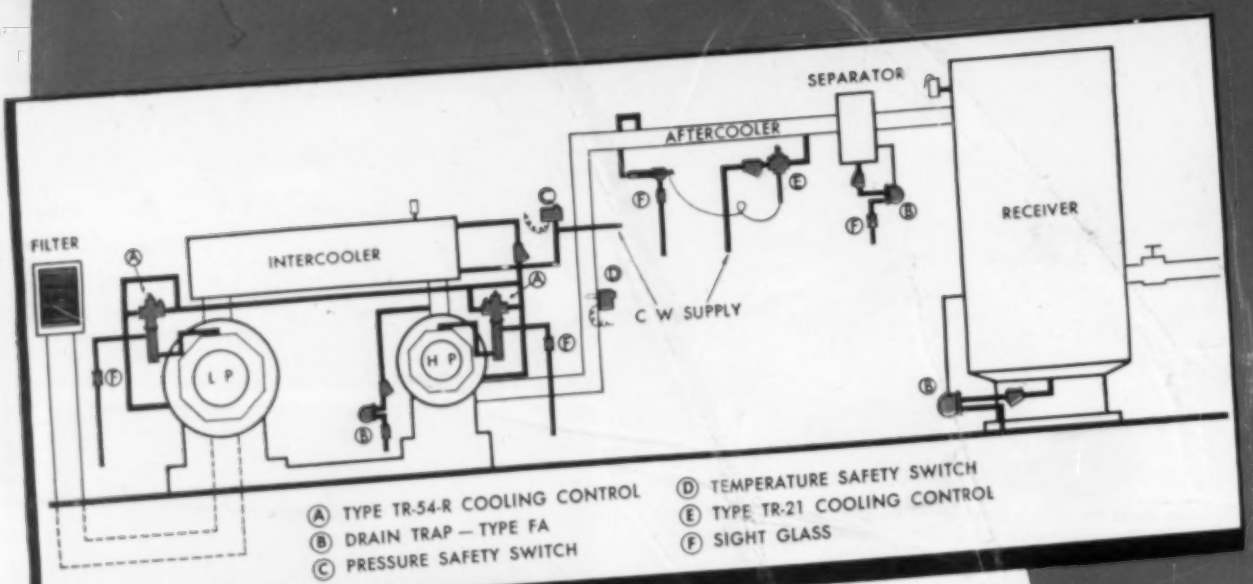
This miner is drilling into the talc orebody with a jackhammer supported by a "Jackleg." Using Bethlehem hollow drill steel and detachable bits, blast holes are put in 6 to 8 ft deep.

BETHLEHEM HOLLOW DRILL STEEL

BETHLEHEM STEEL

to help you solve your

AIR COMPRESSOR PROBLEMS...

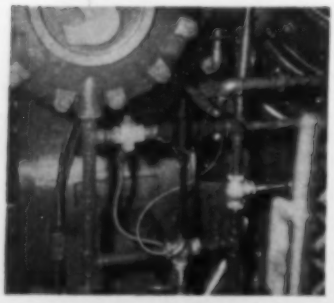


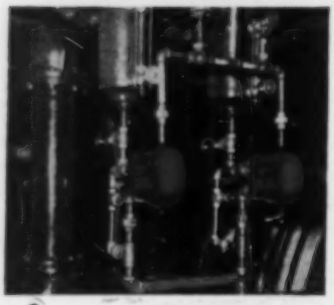
Sarco Accessories on Compressed Air Equipment (one of the illustrations in the bulletin)

write for

TECHNICAL BULLETIN 5-CO...

Sarco type TR-21 Cooling Control on Air Compressor.





Sarco type FA Float Trap draining separators.

THIS BULLETIN is designed to pass on to you the experience of compressed air users and of SARCO engineers, in improving equipment operation without excessive outlay.

You will find also simple hook-ups of SARCO cooling controls, and of drip traps which eliminate condensation from intercoolers, aftercoolers, separators and receivers.

SARCO SPECIALTIES FOR COMPRESSED AIR include also: ELECTRIC SAFETY CONTROLS to shut down the compressor or sound an alarm when the temperature or pressure gets too high or too low in the cooling, lubricating or air systems; and a complete range of pipe line strainers.

Practical advice on how to improve operation of your air compressor—free in Bulletin TB-5-CO.

359

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SARCO CANADA LTD., TORONTO 8, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

FLUOR MUFFLERS and MUFFLER SYSTEMS

with or without air-cooling

For more effective noise abatement, Fluor manufactures a complete line of mufflers ranging from "single element" mufflers to complete muffler systems incorporating a unique "dual element" principle. They are designed to silence 2 and 4-cycle stationary internal combustion engines in the 150 to 3500 H.P. class of virtually every make and model. They meet minimum pressure drop requirements as set by engine manufacturers and are available with or without air-cooled features.

"D" SERIES

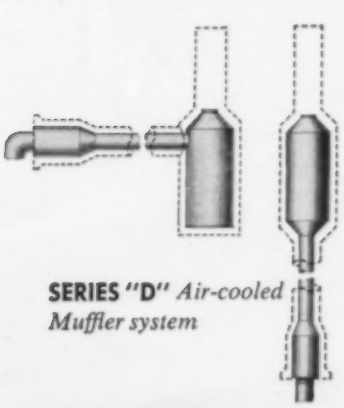
SERIES "D" *Muffler System for 2-cycle engines*

is a dual element muffling system. Two chambers with interconnecting pipe attenuate noise and pulsation in the immediate proximity of the engine. This system provides the highest muffling efficiency obtainable, greater installation flexibility, and a reduction in the size of exhaust piping ordinarily required.

"T" SERIES

SERIES "T" *Mufflers*

This single element muffler for 4-cycle internal combustion engines is designed on the principle of an acoustical low-pass filter which strips out the audio components of sound waves being transmitted through exhaust gases. Low back pressure is a distinct characteristic of the Series "T".

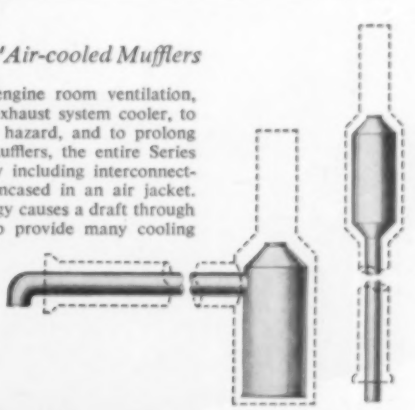


SERIES "D" *Air-cooled Muffler system*

By encasing the muffler system with an air jacket, exhaust energy is utilized to induce the flow of air (via the Venturi principle) which cools the exhaust system, ventilates the engine room and materially lessens spark hazards. Air-cooling also prolongs the life of mufflers by reducing their operating temperature.

SERIES "T" *Air-cooled Mufflers*

To provide engine room ventilation, to keep the exhaust system cooler, to reduce spark hazard, and to prolong the life of mufflers, the entire Series "T" assembly including interconnecting pipe is encased in an air jacket. Exhaust energy causes a draft through the system to provide many cooling advantages.



Shown above are the two types—Series "D" and Series "T", with bottom inlet and side inlet, with air jackets and without. Fluor also engineers and builds mufflers for special requirements. For complete details write for Bulletin FM-8501.

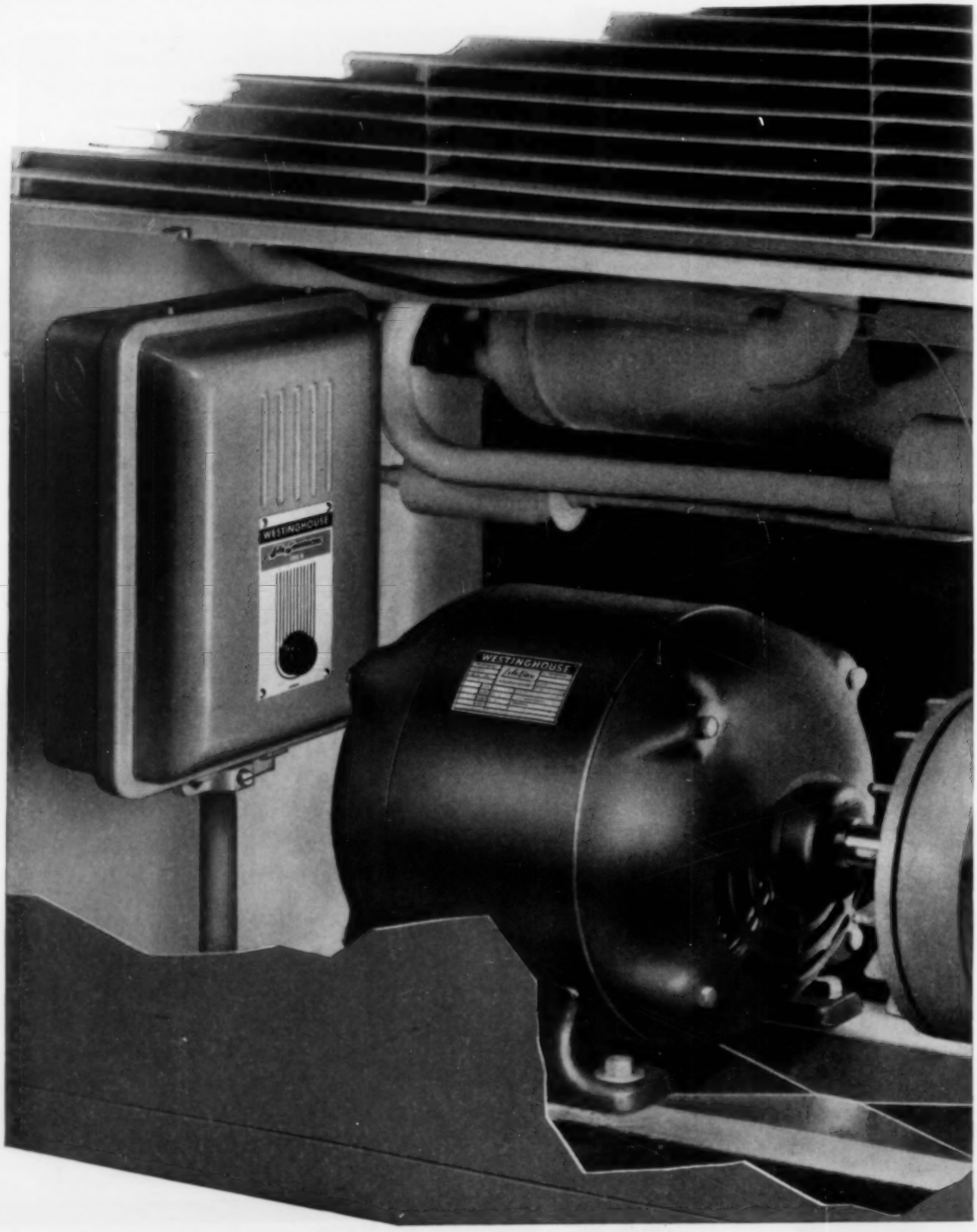
FLUOR

Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD., LOS ANGELES 22, CALIFORNIA

New York, Chicago, Pittsburgh, Tulsa, Houston, San Francisco

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England



WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

So quiet you almost hear the temperature drop!

Air-conditioning equipment should be "felt", not "heard". That's where you get an important advantage with Life-Lines—quiet, vibration-free operation.

Take the smooth-running Life-Line motor. You can actually edge balance a coin on a Life-Line through a start, run, stop cycle. It's that smooth running! The reason? Instead of trying to dampen out noises that may exist, noises have been minimized through motor design, accuracy of manufacture and careful balancing of parts to avoid vibration. Quietness of operation is assured.

Unique starter design reduces electrical and mechanical noises to a new low. Important also is positive action of knife-edge bearing maintaining precise contact alignment. Here, too, quietness is assured.

Together, Life-Line motors and Life-Linestarters® offer you a new concept of motor and control performance. You get more service . . . with less servicing. Ask your Westinghouse representative for complete details on both, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21683

YOU CAN BE SURE...IF IT'S

Westinghouse

Life-Line

MOTORS and CONTROLS

IT'S NIGH ON 100 YEARS

NOW SINCE LAKE SHORE STARTED MAKING MINING MACHINERY - 1958 TO BE EXACT. THAT MEANS A VAST ACCUMULATION OF EXPERIENCE AND KNOW HOW. IT GIVES YOU ASSURANCE OF RELIABLE, WELL ENGINEERED MINING MACHINERY.

SKIPS - HOISTS - CARS - IDLER AND BICYBLE SHEAVES - CAGES - CONVEYORS - SPECIAL MACHINES - ANYTHING AND EVERYTHING NEEDED IN MINING MACHINERY. STURDY PRODUCTS THAT ARE IN USE THROUGHOUT THE WORLD.

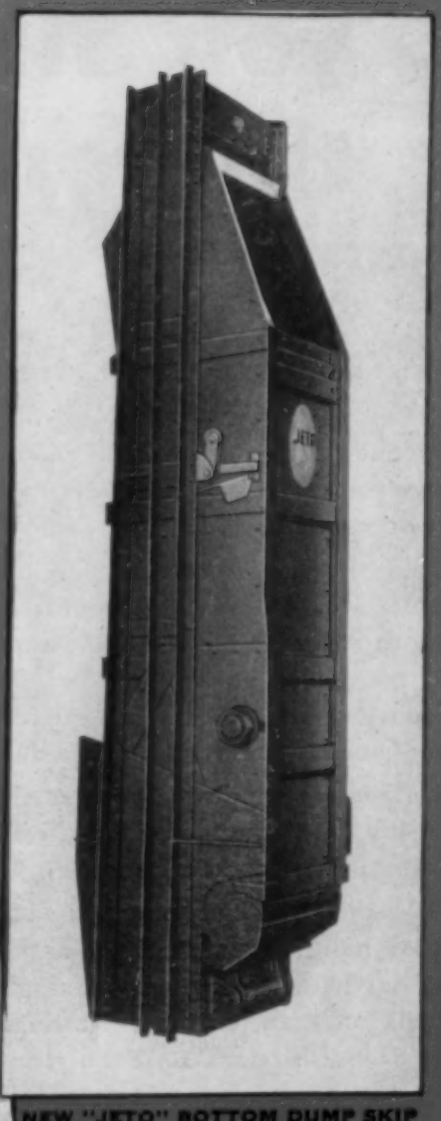
WHEREVER YOU ARE - OR WHATEVER YOUR NEEDS IN MINING MACHINERY OR EQUIPMENT, LAKE SHORE CAN FURNISH IT FOR YOU.

CONTACT THE MINING DIVISION FOR COMPLETE INFORMATION ON ANY OF YOUR REQUIREMENTS.

LAKE SHORE ENGINEERING COMPANY
IRON MOUNTAIN, MICHIGAN

OFFICES: NEW YORK - DETROIT - SAN FRANCISCO
CHICAGO - DENVER - PHOENIX.

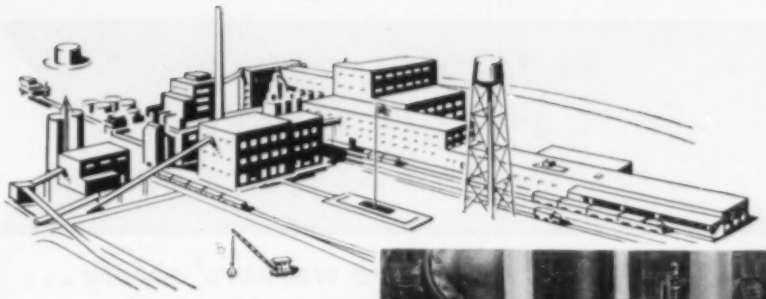
DIRECT ALL INQUIRIES TO IRON MOUNTAIN, MICHIGAN

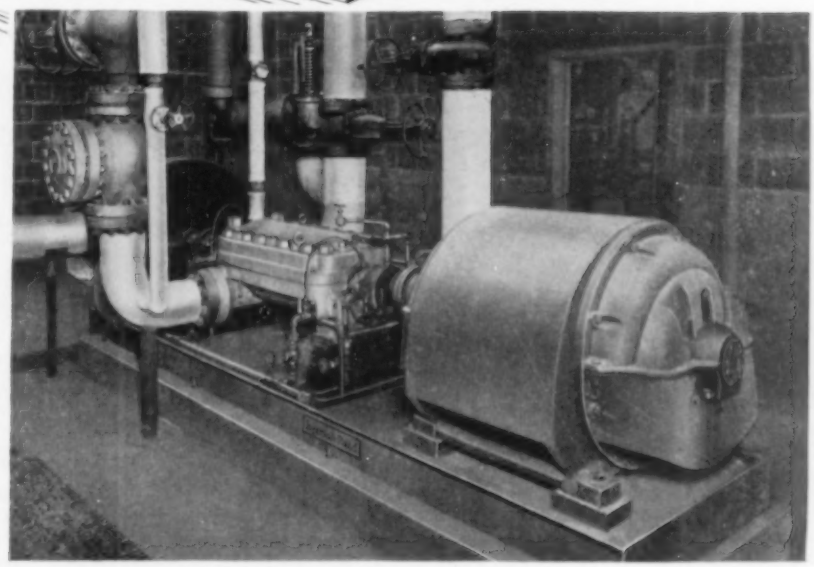


NEW "JETO" BOTTOM DUMP SKIP

LAKE SHORE BICYCLE SHEAVES

THE LOHED MINE CAR





RIEGEL-CAROLINA'S NEW PULP MILL

uses I-R Boiler Feed Pumps

Two 6-Stage HMTA Pumps Help Generate Plant Power

Located on the Cape Fear River at Acme, N. C., Riegel-Carolina Corporation's new mill will produce 200 tons of bleached sulphate pulp daily in full-scale operation. Nearby timberlands in the Waccamaw forest will provide raw material to the 45-acre mill site.

7500 kw of electricity and process steam for the mill is generated on the premises in wood refuse and oil fired boilers. An Ingersoll-Rand, 6-stage Class HMTA centrifugal pump supplies 550 gpm to the boilers at 805 psig. A duplicate stand-by unit is arranged for both turbine and motor drive. Incorporating the Unit-Type rotor assembly designed for higher efficiency and greater dependability, these pumps are, like the mill they serve, completely modern in every detail.

For boiler feed pumps, and for centrifugal pumps for all types of service consult Ingersoll-Rand. Ninety years of experience and the complete line available will result in the best solution to your particular application.

Seventy other I-R Pumps handle these liquids at the Acme Mill:

- Alkaline cooking liquor
- Black liquor
- Heater condensate
- Heavy stock
- Light stock
- Bleach chemicals
- White water
- General service water

Ingersoll-Rand

Cameron Pump Division 741-10
11 Broadway, New York 4, N. Y.

PUMPS • COMPRESSORS • CONDENSERS • DIESEL ENGINES • VACUUM EQUIPMENT • AIR AND ELECTRIC TOOLS

COPPUS "BLUE RIBBON" VENTILATORS

Used in wide variety of applications throughout industry

Improve workers' safety . . . health . . . comfort . . . efficiency

VANO DESIGN "A" VENTILATOR is used here during repairs to a chemical still. This type ventilator is used to ventilate tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments, fuselages and other confined places. Uses 8" diameter flexible canvas tubing ("Ventube").

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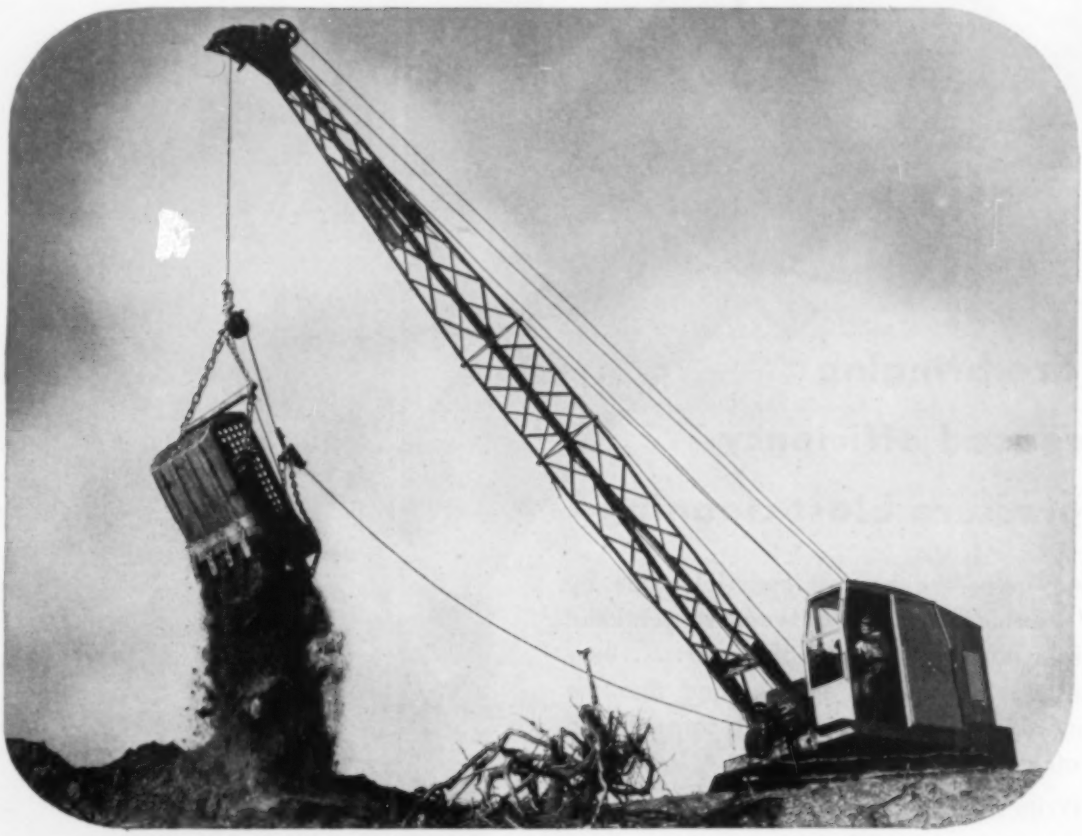

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ON THE COVER

MACHINES belching spray, foggy mist or fine dust are extensively used today in chemical warfare against insects, blight, disease and weeds in the field and farm buildings and on livestock. They come in a wide range of sizes from small hand dispensers to powerful guns and in two classes: the air-pressure and the liquid-pressure type. The unit shown is of the latter class and is applying highly toxic parathion in a Vermont apple orchard. With equipment of this kind it is possible to cover a large area quickly and effectively.

•

IN THIS ISSUE

SINCE the inception of a large-scale electric-power program in France the nation's output has been increased from 433 kw-hrs per capita in 1937 to 750 kw-hrs in 1951 and will be stepped up further when a tunnel project now underway is completed. The bore will carry water impounded in a reservoir at Tignes on the Isère River to the Arc for use in downstream plants that will generate 700 million kw-hrs a year. The undertaking is described in our leading article.

•

THE farmer, more than ever before, is a businessman. He takes in and pays out large sums, deals with ever-changing economic regulations, and manages through mechanization to lower cost of output through volume production. At the time of Pearl Harbor, American farmers had less than half the tractors and motor trucks they own today, and experts estimate that 90 percent of the nation's acreage of small grains will be harvested this year by those mechanical marvels called combines. Now there is a machine available for nearly every job on the farm, a trend that is brought out in an article on *Farm Mechanization*, the first part of which starts on page 129.

•

HOW vital pumps are to our needs is brought out by the fact that they outstrip in sale and production all other types of machinery, not excepting the automobile. In an article beginning on page 133 we tell the story of a 92-year-old pump-manufacturing business that has grown from a one-room shop to a large, up-to-date plant that makes pumps in a wide range of sizes for every field of service.

•

SINKING a slope through hard rock to gain access to lower coal reserves in the Pennsylvania anthracite field calls for highly efficient equipment that will operate safely and economically. See page 140 for the combination slide ramp loader and drill-boom jumbo that was developed for the purpose.

Compressed Air Magazine

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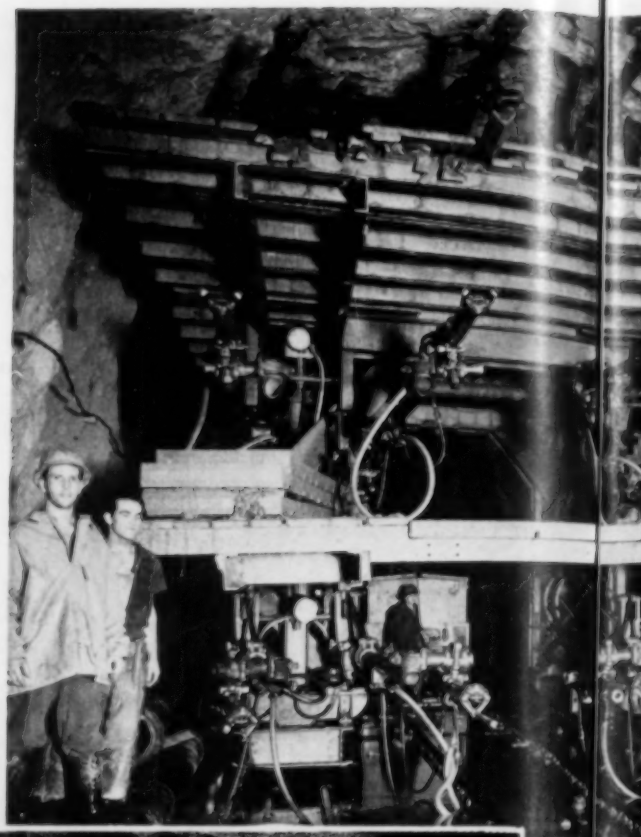
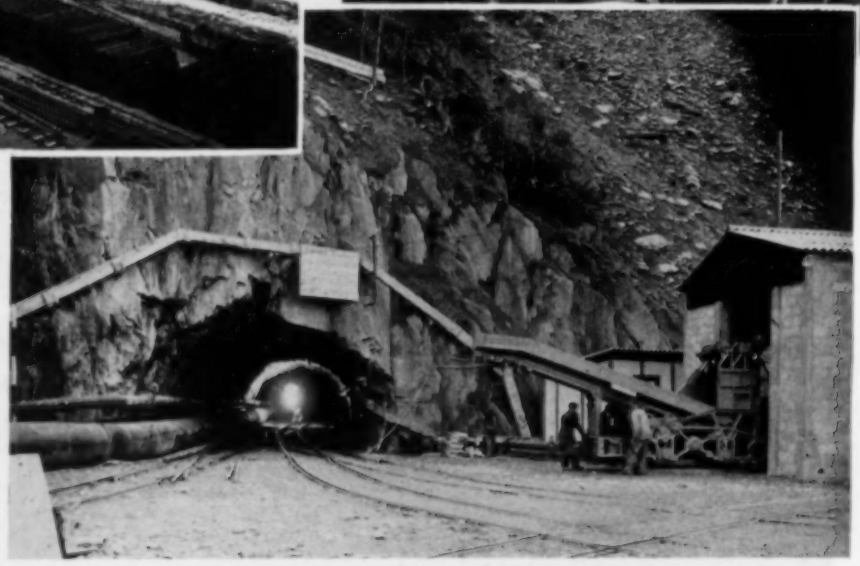
Tunnel Driving in France

American Drills on Large Carriage Make Good Headway in Isère-Arc Bore that Will Carry Water for Generating Power

C. H. Vivian





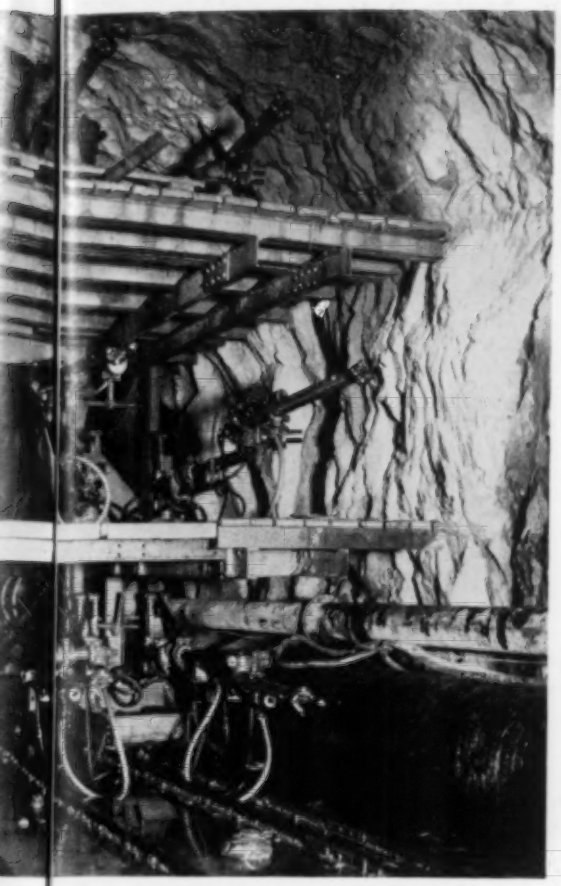
NOTRE-DAME DE BRIANCON

Access to the upstream end of the tunnel is gained through an adit (bottom) at Notre-Dame de Briançon where a concrete mixing plant, compressor building and other contractor's shops are maintained. The machine at the right of the portal is a Conway loader used for mucking. The picture at the left shows a section of the town with materials for use in the tunnel piled in the foreground.

AS A PART of France's program for increasing its production of electricity, a 7¼-mile tunnel of large bore is being driven between the Isère and Arc rivers in the Department of Savoie in the eastern highlands of the country. Both streams are tributaries of the Rhône, which has the largest flow of any French river, and join a short distance downstream from the tunnel. They rise in the Alps, the Arc starting at the base of Mont Cenis which was pierced (1857-71) by the first tunnel driven with the aid of air-powered rock drills.

The headwaters of streams in this area are fed largely by glaciers, and the runoff is greatest in spring and summer. In order to obtain an adequate flow throughout the year for operating downstream hydroelectric plants, it is necessary to store surplus water during those seasons and release it in fall and winter. Carrying out this plan, a 590-foot-high concrete dam that will impound 187,000 acre-feet of water is being erected on the Isère at Tignes, where the average flow ranges from 700 cubic feet per second in January to 4800 in June. By reusing this water several times at successive downstream plants it will generate 700 million kw-hrs of electricity per year, which is 44 percent of the potential power of all the water-storage capacity now available in the country. Sometime in the future additional storage will be provided by constructing the Champagny Reservoir on the Doron River, which flows into the Isère.

The Isère-Arc Tunnel is to be approximately 22 feet wide and 24½ feet high and of horseshoe section. It will take water from the Isère near the town of Moutiers at an altitude of 1545 feet, convey it to the brink of a gorge near the town of Aiguebelle through which the Arc flows and drop it through a vertical concrete-lined shaft, 12.1 feet in diameter, to an underground power plant known as Randens Powerhouse operating under a total head of 501 feet. There will be four generating units, each con-



READY FOR ACTION

The business end of the 2-platform drill carriage photographed while standing a short distance back from the heading during the mucking cycle. By mounting its DA-35 drifters on booms, each can be maneuvered vertically and laterally to cover a considerable area of the rock face. Had they been mounted in a stationary position on the old-style column-and-bar fixtures three times as many drills would probably have been needed. One set of the double rails on which the carriage runs is visible at the right edge of the picture.

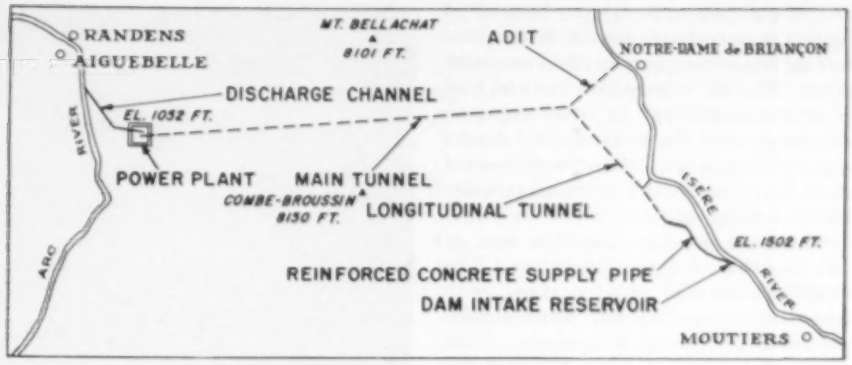


DIAGRAM OF SCHEME

Water taken from the Isère River will be conveyed through the mountains, dropped through the turbines to generate power and then diverted to the Arc River. Both streams are tributaries of the Rhône.

sisting of a Francis-type 45,000-hp turbine driving a 36,000-kva generator. A long tailrace channel will convey the discharging water to the Arc.

Water diverted from the Isère downstream from Moutiers will pass into an intake reservoir and flow from it through a reinforced-concrete pipe, 19.7 feet in diameter and 5904 feet long, into the upstream portal of the tunnel. The narrowness of the valley at that point and the existence of roads and houses limit the size of the intake reservoir. Consequently, its capacity will be only 523,200 cubic yards (325 acre-feet). It is largely because of this factor that the tunnel is being driven with such a large bore. In reality, it will be a medium of storing as well as carrying water and, when filled, will contain 17,650,000 cubic feet of it. It is computed that the maximum flow will be 3530 cubic feet per second. Near the downstream end will be a surge shaft to control variations in flow. With a diameter of 51 feet, a depth of 164 feet, and five horizontal expansion chambers spaced around its upper part, it will be one of the largest openings ever made for the purpose.

The entire project calls for the excavating of 1,817,400 cubic yards of earth and rock. Of this quantity 650,000 cubic yards will be taken from surface openings and 1,167,400 cubic yards from underground. The largest item in the latter category is the 780,000 cubic yards of rock to be removed from the tunnel. The surge chamber will involve the excavation of 286,000 cubic yards of rock. To hollow out a place for the underground generating plant it will be necessary to remove 67,600 cubic yards of rock, and an additional 15,600 cubic yards of rock and 312,000 cubic yards of earth will be taken out of the tailrace channel. All told, approximately 300,000 cubic yards of concrete will be used, 175,500 cubic yards of it for lining the tunnel. Steel requirements will total 5000 tons, of which 3000 tons will be reinforcing for the concrete intake pipe leading to the upstream tunnel portal.

The whole undertaking is sponsored by the National Power Authority, Electricité de France, which has for several years been carrying out a program of construction to increase the country's generating capacity. The project under discussion is one of many on the Rhône River either underway or in the planning stage. The annual French output of electric power is around 750 kw-hrs per capita, as compared with about 2000 kw-hrs in the United States, and it is considered desirable to increase it to improve the general economic welfare of the nation. It is expected that this particular development will begin operating in the latter part of 1953.

The bore is being driven under contract by A. Borie of Paris, reputed to be one of the most experienced tunnel contractors in France. Tunneling was started from both ends: directly and in full section on the Aiguebelle side, while on the Notre-Dame de Briançon side, as an accompanying sketch shows, access to the tunnel line was gained by excavating an adit approximately 3280 feet long from the town of Notre-Dame de Briançon. This intersects the tunnel line near its upstream end, and about half of the length of the bore is therefore being driven on the downgrade. This is complicating matters somewhat, as it means that water issuing from the rocks penetrated accumulates at the drilling face and must be removed continually. Portable Ingersoll-Rand Model 25 sump pumps transfer the water from the heading to a sump located a short distance to the rear. From there, three centrifugal pumps deliver it through a 12-inch pipe to a second sump about 3300 feet back. Another battery of pumps is stationed there, and as the tunnel grows in length the number of sumps and pump installations will increase accordingly. On the Aiguebelle side, where the tunnel is being pushed upgrade, the job is simplified as regards the evacuation of incoming water.

The contractor began driving the tunnel at both headings by means of the so-called Swedish method of drilling and later changed to the latest type of American equipment at the Notre-Dame de Briançon heading. Consequently, the job affords an opportunity to compare these two systems. The Swedish method consists in mounting light hand-held drills on supporting pneumatic legs. Actually this is not exclusively a Swedish development, as similar devices called Jacklegs were introduced by an American manufacturer as long ago as 1938. In the United States the method is favored for mining under certain conditions, but heavier equipment is considered more effective for tunnel driving.

Initially, in the Isère-Arc Tunnel, fifteen drills each weighing about 40 pounds were mounted on a drill carriage or jumbo. The drill steel was ⅞-inch hexagon

of the Swedish type which, instead of having a detachable bit as is the prevailing American practice, is in one solid piece. The bit is forged on one end and is of the single-edge or chisel type, as compared with the conventional American cross-type bit. The Swedish steel does, however, have a tungsten-carbide-insert cutting edge.

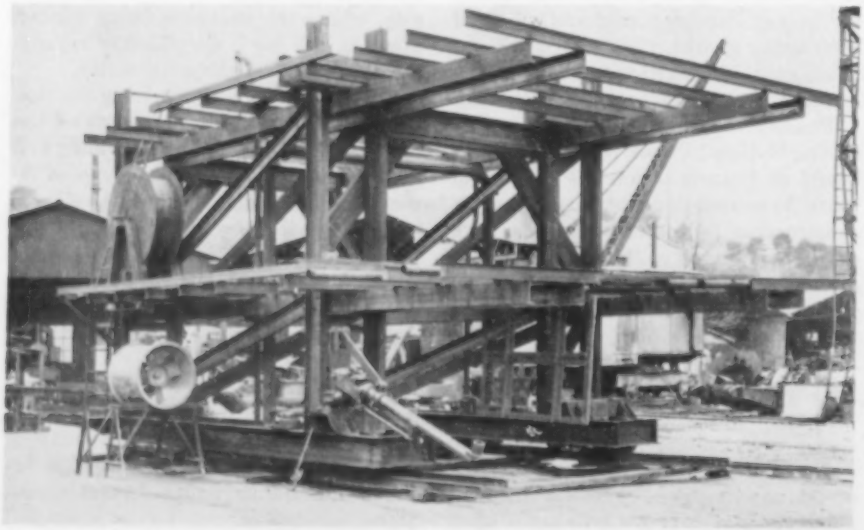
The steels used on this job were of two lengths: 5¼ and 10½ feet. The chisel bit on the shorter steel, with which holes were started, was 39 millimeters (1.27 inches) in diameter. That on the longer one, which followed the starter, was 37 millimeters (1.21 inches) in diameter. The typical drilling round with this equipment consisted of 70 holes each 3 meters (9.848 feet) deep, or a total of 688 feet of hole. These holes, about 1⅜ inches in diameter, were loaded with 9-ounce (250 grams), 30-millimeter (1.18-inch) dynamite cartridges. The Swedes maintain that with this system of small holes they get economy and superior rock fragmentation even though they ordinarily have to drill more holes per round than is the case where larger equipment is employed. These contentions were not proved on this job when hard rock was encountered.

At the Aiguebelle heading, because of bad ground formation which necessitated timbering, the work in full section was abandoned and the contractor had to fall back on the old method of small-section drift heading and then enlarging. At this point progress was slowed down, and as the ground remained very soft at this end the Swedish method was continued with the equipment already on hand.

At the Notre-Dame de Briançon side the rock penetrated varies from what is known as a coal schist with earth layers to homogeneous gneiss. At the start, well-trained miners succeeded in making a daily advance averaging 30 feet so long as the ground was soft. As the tunnel heading pushed ahead the rock grew harder, and with the light drills available it sometimes took three to five hours to drill out a round, and advance dropped to 14 feet per day.

VALLEY OF THE ISERE

This picture and the one on the opposite page are summer and winter scenes of the picturesque Val d'Isère in the heart of France's winter resort country. The tunnel described in this article is on the other side of the highest mountain, about 20 miles away.



JUMBO UNDER CONSTRUCTION

A view of the A. Borie yard at Marseilles at the time the carriage was being built by the contractor from drawings made in the United States. The picture gives an idea of the heavy steel members of which the jumbo was put together. A part of one of the booms that serve as drill mountings is seen at the near corner.

The contract includes a limitation date for the completion of the project and also insures the contractor a liberal bonus for each day he finishes ahead of the expiration date. It is obvious, therefore, that he will benefit financially if he utilizes equipment that will enable him to make the greatest possible progress. Work is carried on around the clock six days a week, and on Sundays it is confined to maintenance operations, laying and adjusting tracks, etc.

In the interest of speeding up operations, the contractor permitted Ingersoll-Rand Company representatives to come in and run some tests with American-made DA-35 drifter drills. Because the only access to the heading was through an opening left in the center of the Swedish drill carriage for the passage of the mucking machine and cars, there was a limit to the size of the equipment that could be assembled. A 2-drill carriage was therefore put together, with the drills mounted on what are known as Ingersoll-Rand jumbo booms. Each boom is moved by an air motor and can be raised or lowered to any desired drilling position in a matter of seconds. A swivel mounting at the base also per-

mits shifting the boom to either side by merely loosening one nut. When the nut is tightened, the boom is held rigid. With a small carriage of this type, two roof jacks, that can be made to exert a pressure of 32 tons, keep the carriage from moving on the tracks on which it runs.

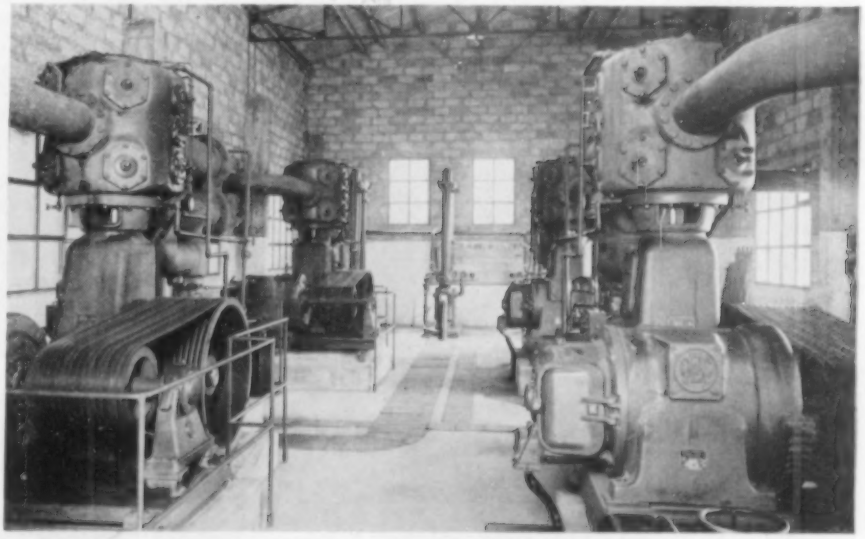
The tests were made in October, 1950, and the results were favorable enough to induce the contractor to try out a full-size drill carriage equipped with DA-35 drills. As a consequence, the assembly of a double-deck jumbo was started in the Borie shop in the suburbs of Marseilles. On it were mounted twelve DA-35 drifter drills with 48-inch aluminum shells, steel centralizers and power feeds. Each drill was set up on a DJB boom, as in the case of the test carriage. As an accompanying picture shows, the latter runs on four rails laid two on each side of the tunnel and about 16 inches apart. The carriage is mounted on four trucks, one at each corner. The two forward trucks have four wheels and the two rear ones two wheels. Room was left in the center for the passage of a mucking machine, locomotives and cars to and from the tunnel heading.

The carriage was fully assembled at Marseilles to make sure that it would function properly and was then dismantled and shipped to the job. Dismantling was necessary to get it into the tunnel through the adit, as the latter was too small to accommodate the structure. It went into service on April 23, 1951, and it was natural that the men needed a little time to learn how to operate the strange equipment. As a matter of fact, they were sure that they preferred the drills they had been using, claiming they were easier to handle. However, after two weeks' practice they announced that they would rather run the drifters on their boom mountings. Once again they explained that the work was easier.

The drifters use carbon-steel Jackrods and 4-point Carset (tungsten-carbide-insert) bits of 1¾-inch gauge. An average drill round consists of 65 holes, each approximately 11.8 feet deep, or about 767 feet of hole all told. From April 23 to July 28, a period of fourteen weeks, 160 rounds were drilled, blasted, and loaded out for a total advance of 1673 feet and an average weekly progress of 119.5 feet. For the 36 weeks from April 23 to December 30, with the heading continually moving farther from the portal and consequently tending to slow down operations, an advance of 3330 feet was made, or an average of 92½ feet per week.

Under favorable conditions a round has been drilled out in one hour and fifteen minutes, and a round has been drilled, loaded and fired in two hours and ten minutes. If other steps in the cycle of operations could be brought to the same relative efficiency as drilling, progress would steadily increase. But as matters stand now the handling of water is a difficult problem, and on numerous occasions work has had to be suspended because of a flooded heading. Other delays have been caused by interruptions in power or voltage drops.

The records show that even though Carset bits are drilling larger holes, they are giving a greater footage than was obtained with the Swedish 1-piece steels with their tungsten-carbide inserts. During the 4-month period previously cited, 415 Swedish steels were consumed in drilling 164 rounds for an advance of 1394 feet. The total length of hole was 112,832 feet, or an average of 272 feet per steel. In comparison, 253 Carset bits drilled 119,733 feet of hole in 22 weeks, or an average of 473 feet per bit. A heading crew on each shift consists



SOURCE OF AIR SUPPLY

Interior of the compressor house at the Notre-Dame de Briançon end of the work, showing four Ingersoll-Rand Type XVH compressors each driven by V-belts from a 203-hp motor. Combined, they have a capacity of approximately 4000 cfm. The air is piped into the tunnel through a 12-inch line.

of a superintendent and 21 men, as follows: one chief miner, twelve miners and six helpers, one mechanic and one electrician. During the mucking period two of the miners run loaders and three others operate the electric locomotives that haul the trains of dump cars in and out of the bore.

Apart from the change made in drills, the equipment in the tunnel remains the same. After completing a drilling round, the carriage is moved back from the heading a distance of from 400 to 800 feet and the round is fired electrically using ten delays of blasting caps. Smoke and gases are then drawn out through a 1-meter-diameter (39-inch) pipe extending to the portal, where it is connected to two 180-hp blowers with valves arranged for either blowing or exhausting. An average of 21 pounds, 14 ounces of explosives is used per cubic yard of material.

When the atmosphere is sufficiently clear for men to return to the heading, two Conway 75-hp loaders are moved forward, followed by two 80-hp, 10-ton electric locomotives pushing strings of empty 5-cubic-yard steel dump cars. In all, there are six rails in the bore, distributed across a width of 4 meters (13 feet). The four inner ones are equispaced, thus providing a set of tracks on each side and a central one, all of the same gauge, approximately 42 inches. In the advanced section of the heading the two outer of these tracks are used by the muck trains, thus enabling the two loaders to work on the muck pile simultaneously. To make sure that both trains are not loaded and ready to leave at the same time, one consists of five cars at the start and the other of nine.

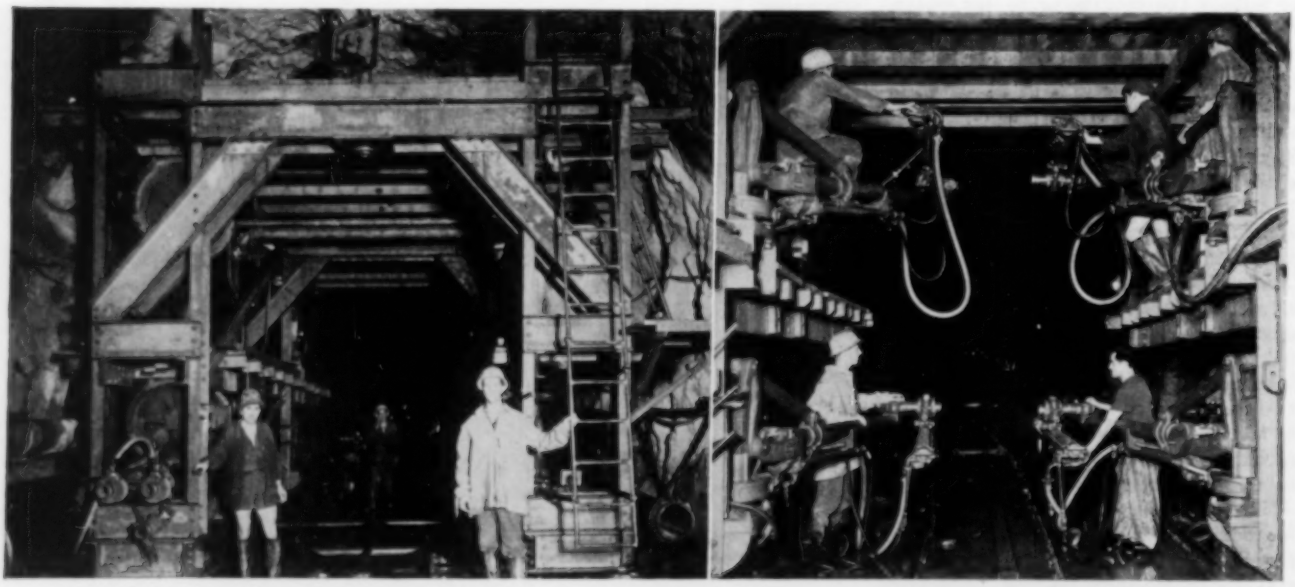
After the car immediately behind a loader has been filled, the train is drawn back to a transfer point where an empty from the rear end is set onto transverse rails that connect the two sets of tracks. As loading proceeds and the two trains shuttle back and forth past the transfer station, empties are shifted from the rear of one to the front of the other. Two sets of these transverse switching tracks are maintained and are located at least 60 meters (197 feet) back from the face. When all the cars of a train have been loaded, they are hauled out to a disposal dump. After the train passes the transfer, it is switched over to the two central rails so that it will pass through the opening in the parked drill carriage. Its position at the heading is taken by another train of empties.

About 6200 feet of the bore has been lined with concrete, and it is intended to continue lining the sides and roof while drilling is going on by pumping the concrete into collapsible steel forms. The invert will be laid later. Up to now no unusual difficulties have been encountered, and the rock is standing well without support. However, as the tunnel will have 6500 feet of burden over it at its deepest point, and as the pressure will be in the range of that experienced in the Mont Cenis, Simplon and other major alpine tunnels, it is possible that lining will then have to follow excavating closely in order to arrest any movement of the ground penetrated. Also, it has been predicted that temperatures up to 98°F will be met, and that the average will be around 95° for a distance of about 1¼ miles in the central part of the bore. The temperature now ranges around 78-80° while mucking is in progress, but drops to 61-64° when drilling is underway, this being attributable to the cooling effect of the expanding compressed air exhausted from the drills.

Compressed air is supplied by four Ingersoll-Rand Type XVH compressors, each driven by a 203-hp motor and delivering approximately 1000 cfm at 100 psi pressure. It is piped underground in a 12-inch main from which two 3-inch hose, 82 feet long, extend to the drill carriage. These terminate in manifolds from which individual smaller hose take-offs run to the drifters. These, as well as the water lines, are carried inside the ribs of the jumbo to keep the platforms clear. Lubricators are incorporated in the air lines serving the drills, with ½-inch connections ahead of them for tapping air used for blowing cuttings out of the holes.

Electric power for operating the Conway loaders is brought into the tunnel at 15,000 volts and stepped down to 380 volts by a transformer located on the side of the tunnel. The latter is electrically lighted, and additional light is provided at the heading by lamps receiving their current from small air-operated generators.

A well-equipped shop keeps the drifter drills in good working order and reconditions Jackrods and Carset bits. To serve the various machines in it, a 2-inch air line runs around the base of the four walls. An Ingersoll-Rand No. 40 drill-steel sharpener is used to forge shanks and threads on rods which are heated in two oil-fired Jackfurnaces. Dulled bits are ground on two I-R bench-model 4G grinding machines.



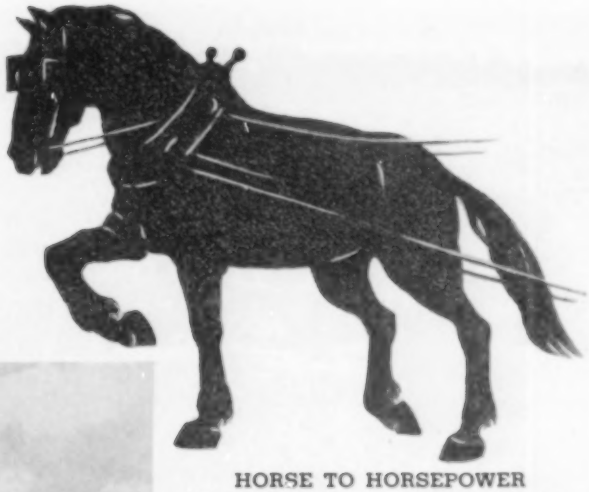
OTHER VIEWS OF CARRIAGE

Here the middle section of the lower platform had been removed to clear a way for the passage of muck trains. The view at the left shows the rear of the jumbo; in the other one, men are demonstrating how the drill booms swing outward. Each is powered by an air motor, and to maneuver it the operator only has to turn a lever.

Farm Mechanization

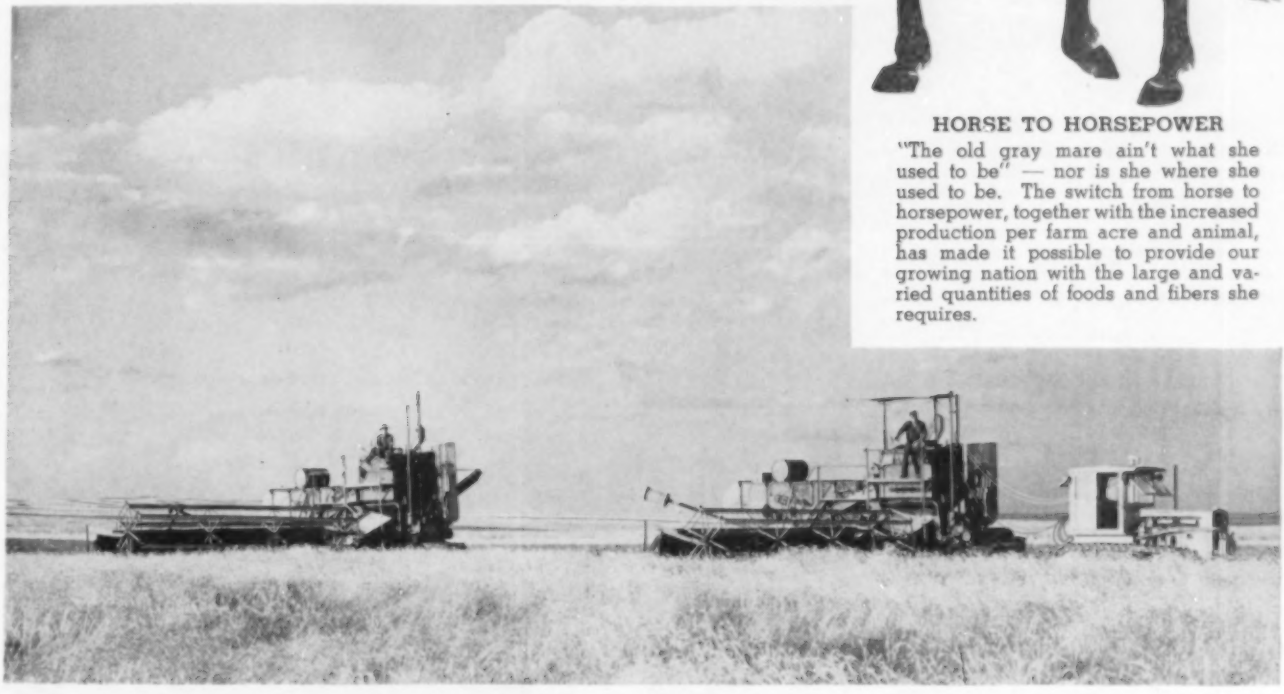
«Part One»

J. C. Pierce



HORSE TO HORSEPOWER

"The old gray mare ain't what she used to be" — nor is she where she used to be. The switch from horse to horsepower, together with the increased production per farm acre and animal, has made it possible to provide our growing nation with the large and varied quantities of foods and fibers she requires.



GID'AP CATERPILLAR

Like reins to the lead horses of a team, air hoses reach from the control deck of the first combine to the tractor pulling both 20-foot units in tandem across Montana wheat fields. Two men and three machines do all the harvesting in 40-foot swaths at the rate of twelve acres an hour. A compressor and an 8x42-inch receiver are mounted at the forward end of the head combine to supply the power by which the controls of the tractor are operated. At the turn of the century, a single unit of comparable size was pulled by 21 horses or mules and carried a crew of five. Three machines, with 63 horses and 15 men, covered about 75 acres in fifteen hours—actually less work than is now performed in the same time by one of the combines shown.

WITH slightly more cropland than was available in 1920 and with 1,300,000 fewer workers, the American agriculturist is called upon to feed 50 million more people and also to meet heavy export requirements. So gradually have the forces at work increased the output of each acre of soil and each unit of livestock during recent years that only those close to farming pursuits fully appreciate the significance of that accomplishment.

An agricultural revolution, kindled more than a century ago, smoldered until comparatively recently when the need of greater food and fiber productivity fanned it into life. It has involved farm mechanization of a high order, as well as improvements in seed culture, animal husbandry, tilling, planting, cultivating, harvesting, marketing and general farm management.

Many pages of the history of agriculture must be turned back to expose the roots of today's tractor-drawn multibottomed gang plows, giant grain combines, ingenious mechanical cotton pickers and other machines that have replaced millions of farm workers while pushing production figures upward. Each of the approximately two million workers in 1820 cultivated enough to support himself and a little more than three other persons. That was quite satisfactory, because there were only 9,638,453 people in the United States at that time, and additional foodstuffs obtained from the sea, from the abundant native wildlife and from foreign sources nicely rounded out the requirements.

But even then there were ominous signs of insufficiencies, for the young nation's population was growing far faster than the output of her farms. Each farmer could care for only a few acres, wildlife became less plentiful, and home needs multiplied by demands from abroad for many essential foodstuffs were increasing. More acres had to be brought under cultivation if they were to be met. Those conditions were the cause of the first squeeze to encourage food and fiber production, and necessity, as always, mothered invention. Some worth-while machines were devised in the years around 1840, among them McCormick's reaper, as well as threshers, mowers and the grain-cleaning fanning mill.

With equipment of this kind each farmer could cover more ground, grow more produce — and the steady development of agricultural machinery was underway. To pull these machines of varying sizes and to haul the heavy loads to market, the horse and mule became more and more important and steadily

MAN AND MACHINES

Wherever one looks on a modern farm one sees machines functioning unattended or operated by a single man doing work that formerly required draft animals and many hands. An example of this is the light 2-row, spring-tooth cultivator at the top loosening soil around young corn. The man at the right busy filling a silo drove the tractor trailer in from the field and in the course of a day can haul and store several more loads of ensilage. Illustrated at the bottom is a multiple weeder on a Montana farm. Mounted on it is a small compressor that is driven through a shaft from the caterpillar crankshaft and powers five horizontal pneumatic cylinders that raise and lower the weeder blades. When World War II took all but a handful of workers from farms like this 9000-acre one, it was necessary to resort to mechanical equipment or let the land go back to wild grasses and weeds.

PHOTO ALLIS-CHALMERS MANUFACTURING COMPANY

increased in numbers until soon after World War I when the tractor, motor truck and automobile began to displace them on a wholesale scale. In 1910 there were an estimated 24,211,000 work animals and only 1000 tractors on the 6,361,000 farms in the United States. In 1920, when the tractor invasion was well on its way, there were 26,742,000 horses and mules and 246,000 tractors on 6,448,000 farms. Today there are in excess of four million tractors on about 5,379,000 farms and only a little more than six million draft animals. The size of the average farm was, of course, affected by mechanization and increased gradually from around 138 acres in 1910 to 215 in 1950.

Incidentally, the year 1910 was of considerable significance in the American agricultural revolution. Then, 11,591,767 persons were engaged in agricultural pursuits — an all-time high. However, in relation to the total working force of 37,370,794 that was only 31 percent, as compared with 1820 when 71.8 percent of the gainfully occupied (2,068,958 out of 2,881,000) worked on farms. Since 1910 the trend has been downward both as to number and percentage, the records showing 9,162,547 or 17.6 percent in 1940 and a further reduction of about 870,000 ten years later.

With the departure of millions of draft animals, 64 million acres on which feed for them was growing were released for raising produce. Based on a 1918-22 to 1940-44 comparison, this diversion is said to account for approximately 30 percent of the increase in marketable farm products, while crop and livestock yields, together with a decline in exports, account for the other 70 percent. All this means that each farm worker is now supporting himself and more than fourteen others, as against nine besides himself in 1920.

Each hour is twice as productive today as it was in 1920, about half of the boost being attributable to mechanization and the remainder to technological advances that have multiplied both the

HARVESTING BARLEY
When the California barley crop is ready for gathering, mechanical giants go out in the fields and do the work in short order. At the left is shown a self-propelled harvester alongside of which is pulled a cat-treaded unit called a "bank-out wagon" from which a screw-type conveyor (below) unloads the winnowed grain into fleets of trucks that haul it to storage points.

PHOTOS CATERPILLAR TRACTOR COMPANY

crop and livestock yield. Because the modern tractor and associate equipment permit the farmer to do his work in far less time than in the past, his contribution to the over-all food and fiber supply is greater and his total physical costs (labor, power, machinery, and other items) per unit of output are lower—have decreased in the neighborhood of 20 percent since 1920. It's the familiar story of higher production bringing down costs.

Farm mechanization was by no means confined to the field. Labor-saving mechanical aids in and about the home, barn, silo and chicken house also played a vital part in increasing productivity, and without them no amount of field mechanization would have brought about the results that have been achieved. In 1898 electric power pumped water and ran a cider mill and a raisin stemmer in California. Across the continent, a few years later, Charles Cook closed a switch on his Mohawk Valley, New York, farm that shot 60-cycle alternating current into a 5-hp motor from a small hydroelectric plant 2 miles away to help him with his chores. That application has been repeated in that one state on more than 124,000 farms and called for 52,000-odd miles of farm power lines.

In excess of 84 percent of the farms in the United States are now served with electric energy by the country's network of transmission lines. Still others have individual generators driven by internal-combustion engines. The extent to which this utility is depended upon for lighting and to operate compressors, pumps, blowers, milking machines, refrigerators, brooders, etc., is indicated by the fact that in 1950 more than seven billion kwhrs worth some $79 million—or the equivalent of the entire TVA hydroelectric capacity—was consumed by the 3,420,000 customers on the transmission systems financed by the Rural Electrification Administration. It is estimated that the total annual consumption on American farms is now around fifteen billion kwhr, of which about 80 percent is used in the homes and the remainder for purposes of production.

Countries other than the United States also have sharply increased output per acre. Great Britain has boosted her yield by about 40 percent since World War II and, consequently, is growing nearly 50 percent of her food. Sweden has doubled the production of her croplands in the past 80 years and reduced the number of farm workers from four million to less than two million. Since 1939, with a 15 percent drop in workers, she has stepped up her agricultural output 9 percent. The recent concentration of machines and science on Canada's farms has brought much submarginal land under cultivation there and greatly increased yields.

Authorities point out that agriculture is only now entering the dawn of mechanization and technological development. On the world's drafting boards are new

AIR CONDITIONED

Operating a combine can be a hot and dusty job, especially in the Salt River Valley of southern Arizona where Charles Saylor is shown on his machine. In addition to the umbrella and water bag to contribute to his comfort, Mr. Saylor mounted a blower on his combine (indicated by an arrow). Currents of air ducted from the fan keep the swirling dust out of his face so that he can watch the operation of the cutter bar, keep the instrument panel clean and prevent excess dust from clogging the motor air-intake screen. Before the blower was installed the bar was often broken and the motor air intake had to be cleaned at least two times a day.

designs for machines and accessories to offset more fully the loss of farm labor to city job, factory and the armed services. Botanists are busy wedding plants to provide species adapted to specific climatic, growing and harvesting conditions. It was from the botanist's laboratory in the 1930's that hybrid corn emerged—a variety which, because of its fabulous yield, has added more than 20 percent to the nation's corn crop. Controlled crossing of specially cultivated parent plants, purified by inbreeding, produced this new corn of sturdier stock and uniformly located ear to better fit the mechanical picker.

Agronomists and horticulturists, working on numerous experimental farms and plots, are never through looking for improved tilling, cultivating and irrigating methods and for fertilizer mixes that will push output upward. The laboratories of agricultural chemists hum with activity that results in more effective fertilizers and soil conditioners, vaccines and insecticides. Krilium, a soil conditioner announced early this year by a leading chemical manufacturer, is said to be about 200 times as effective as equal amounts of compost or peat moss and to point to bigger and better crops from silty or clayey soil.

Also fresh from the chemist's test tube is a sex hormone known as ECP which, it is claimed, makes sheep bear twice as many lambs and which has proved highly successful in overcoming sterility in cattle and swine. While that group of scientists is providing us with more food animals and fiber, other research men are endeavoring to make meat animals and fowl grow faster and heavier, dairy stock that will produce more milk, and chickens that will lay more eggs. Because of their efforts more milk will be supplied in this country in 1952 by 315,000 fewer milch cows than in 1951 and by 4,363,000 less than in 1945. The increase in the output per cow is the outcome of improved feeding and breeding methods. The economic significance of developments of this kind is appreciable.

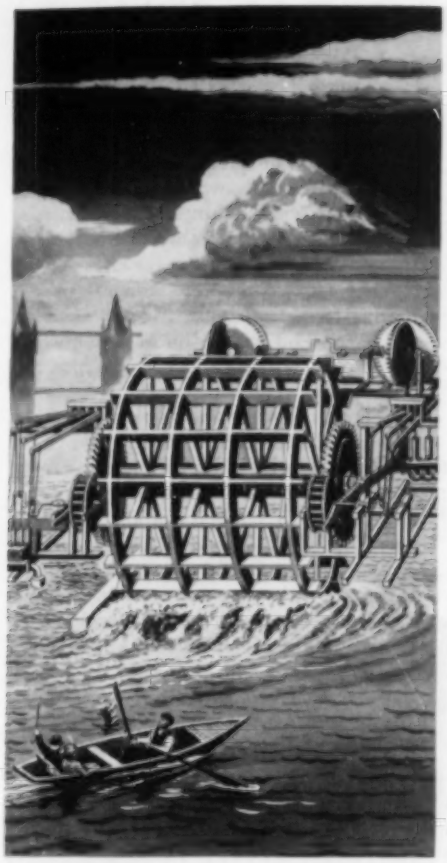
The relentless efforts on the part of this agricultural team seem justified when population forecasts are considered. In the past 50 years the population has doubled to 155 million, and may well reach 190 million by 1975. That calls for a rise in farm production of more than 20 percent from a dwindling force of farm workers and a stable area of tillable soil. (According to Maurice J. Tobin, Secretary of Labor, about 400,000 left farms for jobs in industry in 1951.) In order to meet the estimated 1975 requirements, it will be necessary to increase the number of beef cattle and hogs by 15 million and 25 million head, respectively, and the yield of milk by 30 billion pounds per year, eggs by 15 billion pounds, corn by 600 million bushels and wheat by 225 million bushels. Little wonder, then, that the race to mechanize the farm and to top the yield-per-acre records continues. Farmer, scientist and implement manufacturer have a big job ahead.

The outlook indicates a big potential market for agricultural machinery. It is estimated that in the next five years the American farmer will spend more than two billion dollars on electrical appliances alone, and about $675 million on electric production equipment such as crop driers, milking machines, water systems and brooders. Add to that his expenditures for tractors, trucks, plows, combines, compressors and small tools (in excess of $2600 million in 1949), and it becomes apparent how much the agriculturist depends on industrial products.

The concluding installment will appear in the June issue.

ELECTRIC MOTHER

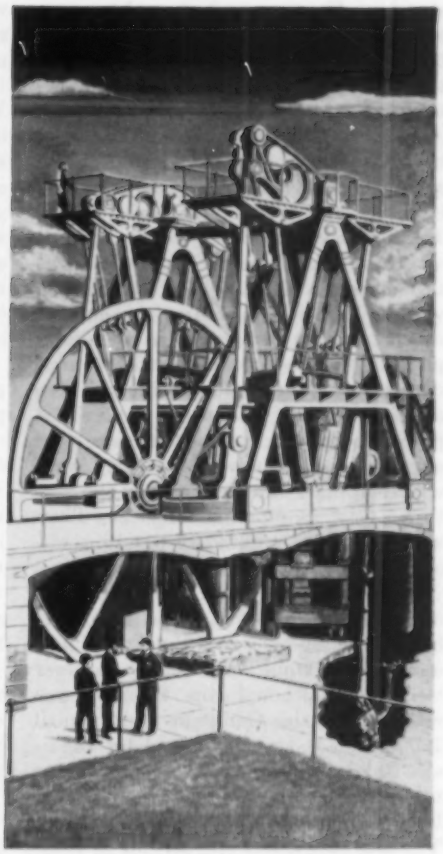
Mass production of broilers is the business of Glenmont Farms near Albany, N. Y., where modern equipment pays dividends. Shown here is a floor-heated brooder house provided with thermostat controls, infrared lamps and other devices to promote fast growth. The 2-floor 30x200-foot building is believed to be the largest of its kind in America. Between 1000 and 2000 chicks are started towards broiler size each week.



CAMERON PUMPS

Their Origin and Development

George V. Shaw



FORERUNNERS OF TODAY'S PUMPS

London, England, had a water-supply system as far back as 1582 when pumps were installed in one of the arches of London Bridge. Those units were driven by the tidal flow of the River Thames through a series of undershot water wheels (left). Others were subsequently added, and the system remained in service until 1822 when the bridge was torn down for a new structure. The other drawing shows a cumbersome compound-beam, steam-engine driven pumping engine that is typical of the units that were in service during the latter part of the nineteenth century. It was designed by E. D. Leavitt, Jr., and supplied the citizenry of Lawrence, Mass., with water.

MOVING water from one elevation to a higher one is one of the most ancient of the arts. The designing of equipment to do this job has challenged the ingenuity of mechanics and engineers throughout the ages. The calabash, or gourd, was probably the first appliance used by primitive peoples to raise water, but as time went on and wells became deeper the water could no longer be reached by a hand-held vessel. The simple bucket and cord then came into common usage, and in Egypt the rope for lifting the vessel was reeved through a pulley supported by a post and arm above the well.

In time, those devices were supplemented by the swape or shadoof, a lever swinging on a fulcrum. One end of the lever carried a pole and bucket while the other was counterweighted to assist in raising the filled container. Another ancient pump of interest was the Egyptian screw, sometimes called Archimedes screw, which consisted of a tube wrapped in a helix about an inclined axis.

The actual dates when these and many other ancient methods of raising water were invented are obscure. Possibly, those simple machines, born of necessity, were not considered important enough at the time to be noted for posterity. The first recorded installation of machine pumps was in London in 1582. Designed by Peter Morrys, they were of the piston and valve type, forerunners of a now familiar design. Because no steam engines or electric motors were then available, those units—located in one of the arches of London Bridge—were driven by the tidal flow of the River Thames through a series of large, undershot water wheels.

The invention of the steam engine by James Watt in 1765 sparked improvements in pumps. However, Thomas Newcomen first employed steam in 1705 to operate a water piston principally for pumping out mines. The early steam pump was a cumbersome affair. There was plenty of room for improvement, and as need for better machines arose, designing pumps became a more exacting science. By the beginning of the nineteenth century several crude forms of the centrifugal pump had been built, and by 1840 the forerunners of our present highly efficient machines began to make their appearance.

Not many years later, a young fellow named Adam Scott Cameron entered the picture. Hardly more than a machinist's apprentice, he migrated from Scotland to the United States where he landed with plenty of courage and ambition but little else. By working at his trade during the day and devoting his evenings to study, he was able to complete an engineering education of sorts at Cooper Union in New York City. In his little shop at Twenty-Second Street & Second Avenue, opened in 1860, Cameron bent his energies to improving the existing means of pumping water. His efforts towards that end were so successful that he outgrew the 400 square feet of floor space in only eight years and took over buildings formerly occupied by the city jail in the block bounded by Twenty-Third and Twenty-Fourth streets, First Avenue and Avenue A. After adding a 3-story

structure, Cameron had a complete manufacturing plant, including pattern shop, brass and iron foundries, assembling and testing departments, warehouses and offices.

Cameron produced a double-acting, horizontal-piston simplex pump that was outstanding in its field. It was simple in design and foolproof in construction. The key to its success lay in the absence of outside valve gear. Operation was controlled by a simple steam-thrown valve. This design became the nucleus of the entire Cameron line of steam pumps—the accepted standard for innumerable purposes where reliability was a prime factor. Cameron boiler-feed pumps, both stationary and marine, were among the best examples. They were widely applied and were among the first to be used in pipe-line service. They were especially suitable for handling viscous liquids such as fuel oil or molasses.

Cameron's life was a busy but short one, for he died at the age of 40. After his demise, operation of the A. S. Cameron Steam Pump Works was taken over by others, although the business was retained by the Cameron family until 1909 when it was purchased by Ingersoll-Rand Company. It is interesting to note that the Cameron valve gear first used in 1860 was never changed. The fact that it was still serving in 1950, when the company discontinued the commercial manufacture of steam pumps, testifies to Cameron's inventive genius.

In 1912, despite the fact that the New York factory had been equipped with improved machinery and production was increasing, the business had completely outgrown the available quarters. That year the old plant was abandoned and a new one opened in Phillipsburg, N. J., covering an area approximately three times as large. Though not the biggest, it was probably the best-equipped pump shop in the country.

The entire output of the old Cameron plant was confined to direct-acting steam pumps, but by the time the move was made to Phillipsburg the centrifugal had already developed into a formidable rival. Sensing that the reciprocating pump was to be superseded by the centrifugal in most applications, the company established an engineering department for the design of this important new type and set up equipment for its manufacture in the shop. Now the Cameron plant is given over exclusively to the manufacture of centrifugal pumps, except for the few parts that are needed to keep in operation the thousands of direct-acting pumps still in service.

The centrifugal pump was not new in this country and not far advanced when Ingersoll-Rand started building the type in 1912. The first machine based on that principle is said to have been invented by Le Demour, a Frenchman, in 1732. It was merely a straight tube attached at an angle to a vertical shaft which was rotated by hand. The centrifugal was slow in developing because it requires rotational power from an outside source. It was not until the steam turbine and the induction motor were available as sources of that power that pumps of that type came into general use.

In 1818, a crude centrifugal was made in Boston and called the Massachusetts Pump, but 82 years were to elapse before the type could be considered a competitor of the direct-acting machine. At the turn of the century there were several concerns manufacturing centrifugal units, but those pumps were greatly limited as to capacity and head. It was during this period that the Fifty-Eighth Street power plant of the New York subway was under construction. The inadequacy of the centrifugal pumps then available is brought out by the fact that it was necessary to install direct-acting circulating pumps, each driven by means of a vertical cross-compound Corliss engine, for the 25,000-square-foot condensers. In the meantime the station's 6000-hp engine-driven main generators have been replaced by turbine-driven generators and the direct-acting circulating pumps by centrifugals.

For a description of a simple centrifugal we can do no better than lift a part of the text from Dr. A. J. Stepanoff's book *Centrifugal and Axial Flow Pumps*. He says: "Every pump consists of two principal parts: an impeller which forces the liquid into a rotary motion by impelling action, and the pump casing

OLD AND PRESENT PLANT

Eight years after Adam Scott Cameron began manufacturing pumps in New York City in 1860, he moved his one-room shop to a group of buildings that covered nearly a block (above). The works remained there until 1912 when Ingersoll-Rand Company, which had purchased the business in 1909, built a modern plant at Phillipsburg, N. J. (right).

which directs the liquid to the impeller and leads it away under a higher pressure. The impeller is mounted on a shaft which is supported by bearings and driven through a coupling by a driver. The pump casing includes the suction and discharge nozzles and houses the rotor assembly .... Liquid is directed to the impeller eye by the suction nozzle and is brought into a circular motion by the impeller vanes. The impeller vanes and impeller side walls, or shrouds, form the impeller channels .... As a result of the impeller action, liquid leaves the impeller at a higher pressure and velocity than it entered. The velocity of the liquid is partly converted into pressure by the pump casing before it leaves the pump through the discharge nozzle .... The volume of liquid pumped is referred to as capacity and is generally measured in gallons per minute. The height to which the liquid can be raised is called head and is measured in feet .... The degree of hydraulic and mechanical perfection of a pump is judged by its efficiency. It is a ratio of pump energy output to the energy input applied to the pump shaft."

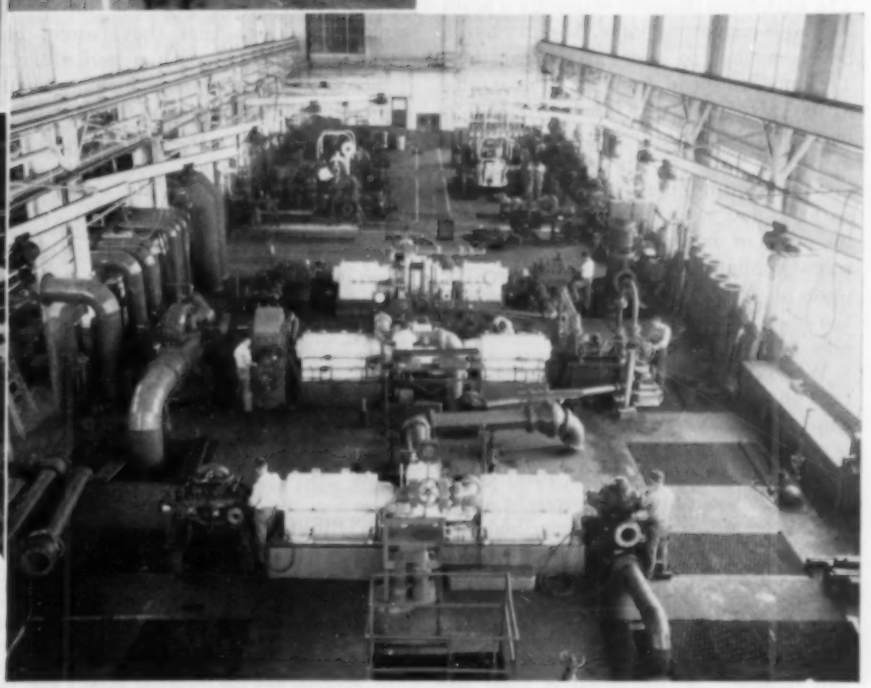
Several simple analogies will enable you to visualize these fundamentals. Suppose you had a pan partly filled with water. If this pan were to rotate about a vertical axis, the water would overflow. Because of the centrifugal force involved in the rotating motion the water would be lifted (or pumped) to a higher head. Next, if you had a bucket of water with a hole in the bottom and by means of a rope whirled it over your head, the water would be thrown a considerable distance. The faster you whirled, the sooner the bucket would be empty and the farther the water would be thrown. In other words, the increase in speed would increase the centrifugal force and you would pump more water to a greater height or head.

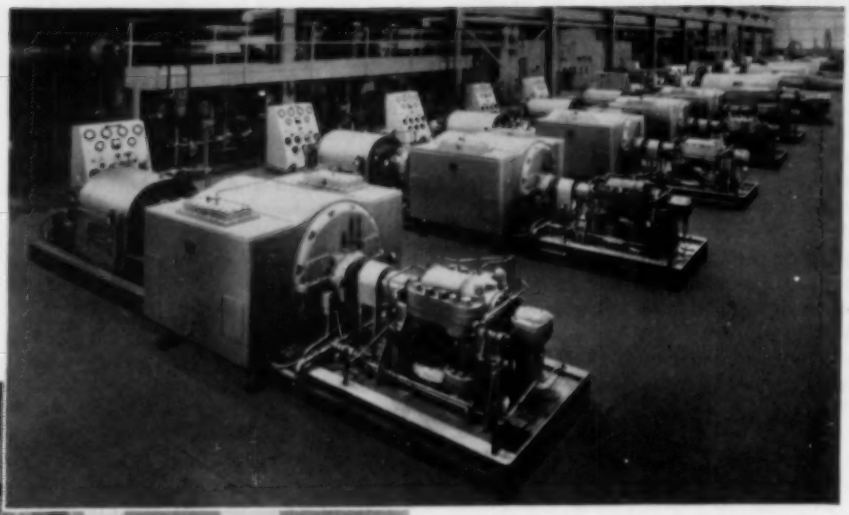
If the molecules of water entering a pump impeller were suddenly solidified into BB shot, the velocity with which they would be thrown from the periphery of the rotating impeller would be much greater than that at which they entered the eye. Assume that there is a steady stream of shot being thrown out. If it were allowed to go free through the air, no useful work would be done. Suppose, however, that a tin can were placed in line with the shot. In that case the can would be moved. In other words, by losing its velocity the shot exerts pressure on the can. That is the usable form of energy we want in pumping. In a centrifugal pump the volute casing or diffuser vanes serve to convert an appreciable amount of the velocity energy of the liquid leaving the impeller into pressure energy.

There are two general classifications of centrifugal pumps: single stage and multistage. Single-stage units are used for moderate heads or pressures, the capacity and head being governed by the allowable impeller diameter and speed consistent with high efficiency. There

ASSEMBLY FLOOR AND TESTING LABORATORY

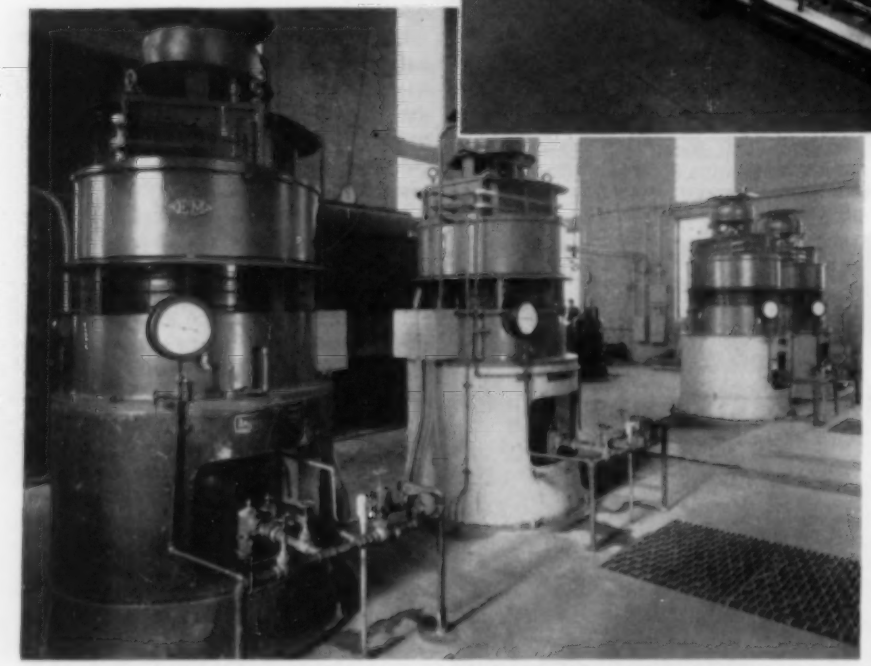
Directly below is shown a section of the long bay where the parts from the fabricating and finishing departments come together and are assembled. From there the completed pumps go to the hydraulic laboratory (bottom-right) which is equipped to test units from ¼ to 2700 hp. against heads up to 8000 feet. Underneath the floor is a 2-walled 400,000-gallon concrete reservoir.





POWER-STATION SERVICE

The installation at the right shows five boiler-feed pump sets, complete with instrument boards, each made up of a 5-inch, 8-stage unit (left) and a 6-inch, 3-stage unit (right) with a 2000-hp water-cooled motor between them. Bottom suction and discharge on both pumps makes for a neat appearance. Where space is at a premium, vertical mixed-flow pumps are well suited for circulating condenser cooling water. The 2-stage units pictured below are pumping river water at the rate of 18,000 gpm against a head of 80 feet.



are three types of impellers for centrifugal pumps, the choice depending on the flow characteristics to be obtained. The high-head impeller is usually a plain or single-curvature vane, the discharge being normal to the axis of rotation. The medium-head impeller is generally of the mixed-flow or Francis type which has a double curvature, or what is called a warped vane, at the inlet end. The low-head pump may be designated as an axial-flow or propeller pump because its impeller is more in the form of a screw similar to a ship's propeller. In units of this type the liquid approaches the impeller axially and the flow is parallel to the shaft.

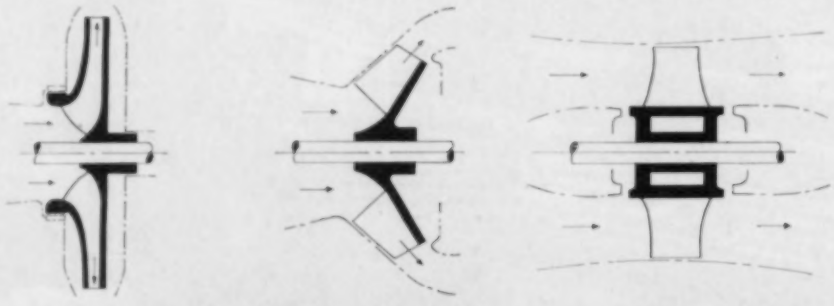
When the pumping head is higher than that obtainable with a single-stage pump the impellers are arranged in series in a casing, each impeller or stage developing its increment of the total head. With the exception of the straight axial-flow type, the impellers described can be used in horizontal or vertical multi-stage pumps.

There are few hydraulic or mechanical limits to the applications of modern centrifugal pumps or the liquids they can handle. So universal is their use that the few services for which direct-acting pumps are still required lie in the range of very low capacities and high heads, or in handling liquids having a viscosity so high that they cannot be pumped efficiently with a centrifugal.

The centrifugal is more flexible than the reciprocating pump so far as capacity is concerned. It is capable of an output ranging from zero flow to the full volume for which a unit is designed. The pressure developed in a centrifugal depends on the diameter of the impeller, or impellers and the operating speed. For a given speed and capacity, only one pressure can be obtained. With direct-acting pumps, at a given speed and capacity, an infinite number of pressures can be obtained within the limits of structural design.

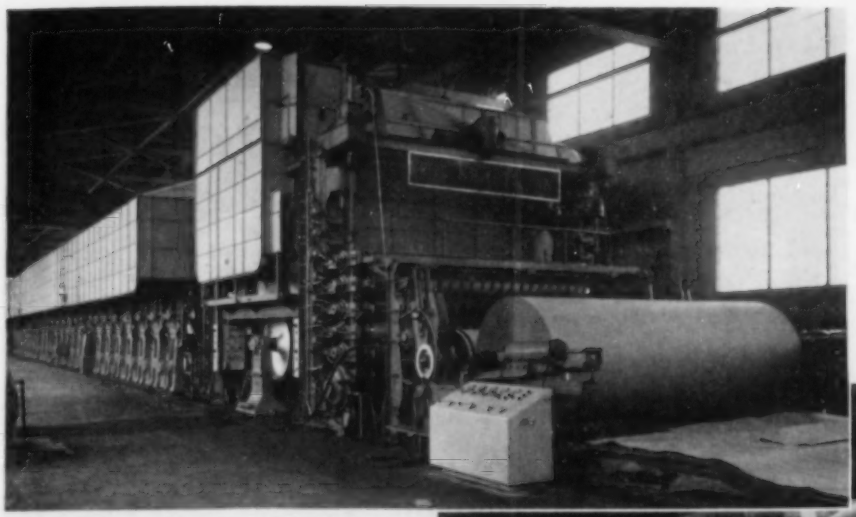
The SV single-suction open-impeller pump was the first Cameron centrifugal to be turned out in quantity. The unit was built in sizes from 2 inches to 10 or 12 for a top capacity of approximately 3000 gpm largely for general water service and remained in production until about 1922. It was of simple design, as we know centrifugal pumps today.

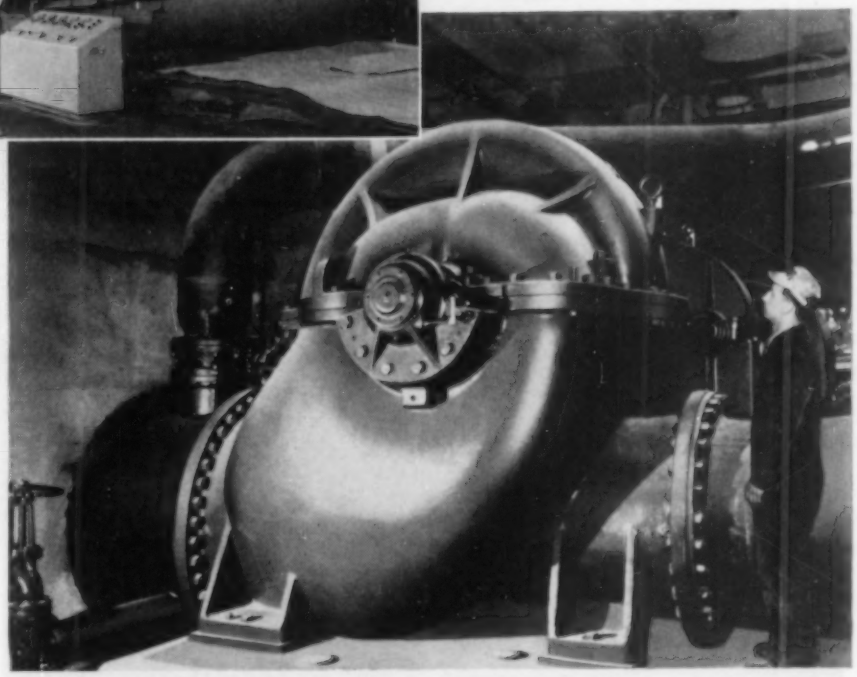
About the time Cameron moved from New York to Phillipsburg, the Panama Canal was nearing completion and large numbers of centrifugals were needed for draining culverts and lock gates and for operating the hydraulic chain fenders which acted like shock absorbers to prevent ships from damaging the gates. Cameron quoted on that bid and re-



PUMP IMPELLERS

Shown here diagrammatically are the three types used: Left, plain or single-curvature impeller with the discharge normal to the axis of rotation for high-head pumps; center, Francis or medium-head type with a double curvature at the inlet end; and, right, propeller or screw type for low-head pumps in which the liquid approaches the impeller axially and the flow is parallel to the shaft.





IN A PAPER MILL

Big Fourdriniers like that shown at the left can produce 550 tons of kraft paper daily when operating at 1500 feet a minute. To keep a machine running at that speed the stock has to be fed to it in a steady stream of riverlike volume, and that work is done by what is called a fan pump. The unit pictured has a capacity of 40,000 gpm when handling stock of 0.2 percent consistency against a head of 30 feet.

ceived an order for some 60 units. That was rather spectacular in those days and started a curve of production and pump sales that has climbed steadily as applications for centrifugal pumps increased and the lines expanded.

Of the Panama Canal pumps, 48 were for use in connection with the chain fenders. They were 5-inch, 2-stage machines with a capacity of 1200 gpm and for an approximate total head of 300 feet when operating at a speed of 1750 rpm. Though but a 2-stage unit, it was the forerunner of the well-known Cameron line of high-pressure multistage pumps.

Since Cameron first became a part of the Ingersoll-Rand family the nation's industrial expansion has been tremendous. With that development and our almost complete electrification has come an increasing demand for pumps until today they far outstrip in production and sale all other types of machinery, including automobiles, airplanes, steam turbines, diesel engines and refrigerators, combined. When one considers that each product named uses one or more pumps of the centrifugal or positive-displacement type, the total pump-production figure becomes impressive.

With the nation's ever-growing demand for power, generating plants have increased in size. Higher central-station pressures have resulted in greater economies and placed more emphasis on the design and reliability of the pumping equipment serving the boilers. Condensers, too, are larger, and require larger circulating and condensate pumps.

The quality of a product depends not only on the excellence of the design but also on the character of the workmanship that has gone into the execution of the design. Customers who have visited the Cameron shop praise it as a model of good housekeeping and management. Orderliness is not "show" for the visitor—it is a daily habit.

The machining and finishing operations are accomplished in departments fully equipped to perform their jobs with speed, precision and efficiency. Rough iron, bronze and steel castings for the casings of centrifugal pumps enter the main bay from the storage yard or foundry. As they proceed up the bay on their way to the assembly floor they undergo various machining operations, inspections and tests. The same flow of parts is seen in the bay where hundreds of sizes and types of impellers are machined from bronze, steel and alloy castings. In the area devoted to the production of shafts, special equipment is available to grind and finish the steels used for that purpose.

The focal point of these fabricating and finishing departments is the assembly floor, which covers more than 100,000 square feet. There all the parts that make up a complete pump are put together with the same care that marks each step of their manufacture. Some of the parts go into storage where, with tens of thousands of others, they are held in readiness to fill spare-parts orders or go into new pumps. From the assembly floor, each unit is moved to the testing department where it is given a complete hydraulic performance check. This assures the purchaser a pump that will operate well mechanically and meet the hydraulic guarantees made when it was purchased.

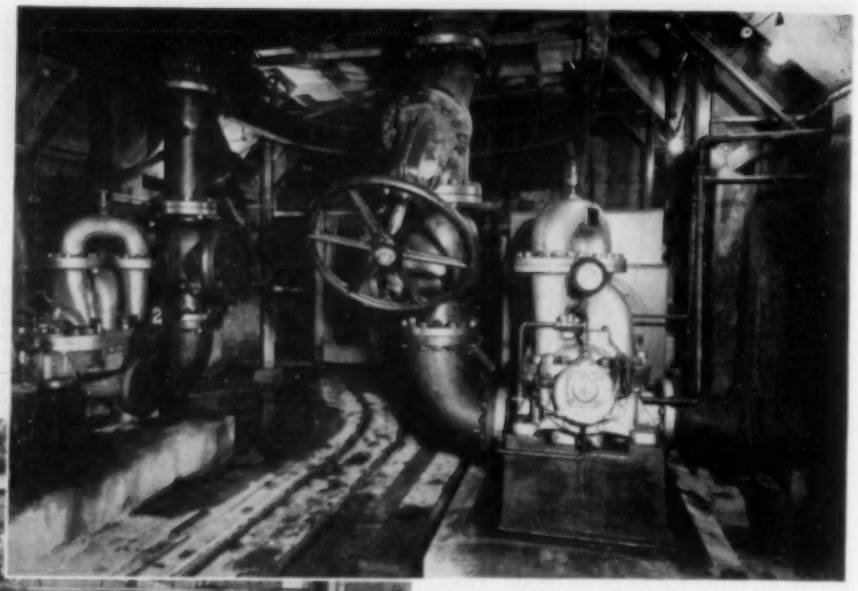
With the rapid increase in the use of centrifugal pumps and the production of units of larger capacity for higher-head services, it became apparent in the late twenties that the testing equipment, provided when the shop was opened in 1912, was inadequate for checking the prevailing hydraulic characteristics and power inputs.

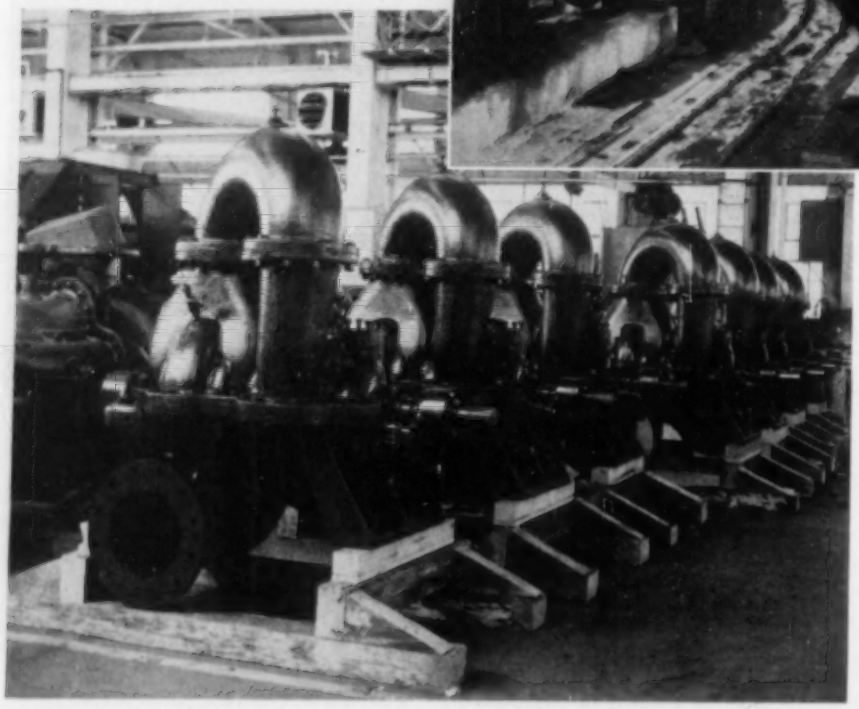
It was then that the company's technical staff designed the present modern testing department. Built in 1928-29, it is an important part of the Cameron plant and one of the finest of its kind in the country. It has facilities for checking pumps ranging from ¼ to 2700 hp, quantities up to 70,000 gpm and heads to 8000 feet at any speed up to 7000 rpm. Units requiring less than 150 hp are tested with electric dynamometers and larger pumps with turbine-driven dynamometers.

Two general lines are built—the commercial and the engineering line. The latter includes all multistage, special-

TYPICAL APPLICATIONS

Here we see Cameron pumps designed for two divergent services. The installation at the right is part of a centralized copper-mine drainage system that feeds a reservoir from which the pumps take suction. They are built of special alloys because of the highly corrosive character of the water. At the bottom is a shop view of a group of marine pumps for tankers that serve the dual purpose of unloading oil or gasoline and of filling the empty tanks with sea water for ballast. They are made of bronze to resist the corrosive action of salt water and have a capacity of 3000 gpm.





application units and single-stage pumps above the 12-inch size. In the commercial line, the close-coupled Motorpump and its companion, the single-suction coupled pump, are represented by approximately 100 different pumps of single-, 2- and 4-stage design. A recent Motorpump development is a self-priming unit for services calling for intermittent operation. A partial list of the industrial users of Motorpumps includes builders and contractors, chemical works, dairies, distilleries, breweries, packing plants, oil refineries and a host of others.

The field for the engineering line is narrower but still sizable. Power plants have developed greatly in the past three decades both as to size of generators and steam pressure carried to drive the turbines. Up to about 1922, Cameron's boiler-feed pumps were multistage turbine units, designated as types MT and ST. Successors of the Panama chain-fender pumps, they were good for pressures of about 600 pounds. But pressures had started to go higher and pump designs had to be changed to parallel that advance. The next step was the development of heavy boiler-feed pumps along the same general line of the previous models but producing pressures up to 1200 pounds. Known as the HMT's they were the Cadillacs of boiler-feed pumps, and for reliability have never been excelled. Some have piled up more than 80,000 hours of service — without being opened.

Today it is not uncommon to find boiler plants operating on steam pressures of 2000 psi and higher. Cameron's answer to this challenge is the vertically split, forged barrel pump. The fact that some now on order require 3000-hp driving motors gives an idea of the size of these units. They are truly the aristocrats of modern pumps.

Steam pressures have gone up in industrial boiler installations as well as in power plants, but as a rule the pressures are not so high and the conditions can be met with horizontally split multistage units. Until of late, the HMT was the pump used in this service. However, steel casings are needed in most cases to handle the feed water.

The refining branch of the petroleum industry, including modern high-pressure gasoline extraction plants for converting natural gas into gasoline, offers a good market for Cameron pumps. Many refinery applications have proved troublesome in the past because of the difficulty encountered with flammable stuffing-box leakage. Ingersoll-Rand's answer to this problem is the Cameron Shaft Seal, introduced in 1928 and recently incorporated as standard equipment in a new compact design of refinery pumps which require no stuffing-box attention or maintenance and have set a new high in safety and dependability.

After an extensive survey of pump uses and liquids handled in the chemical industry, Ingersoll-Rand's metallurgical department developed the material that now bears the trade-mark Ircamet. This steel alloy is the best solution of most corrosion problems and is now standard in the chemical-pump line, which consists of fifteen pumps of different sizes ranging from the ¾-inch model to the 10-inch unit.

At the outset of this article it was stated that water is the element most important to man's existence. That is probably so, but without paper on which to record his thoughts and lay out his plans man would have had difficulty in progressing beyond the Stone Age. Most of the paper used today is made from wood reduced to cellulose fibers either by a chemical or mechanical process. One way or the other, numerous pumps of many varieties are needed to convey the pulp from one manufacturing stage to the next.

Water is used in large quantities and is pumped to the mill by single-stage, double-suction pumps. Rough stock, obtained by cooking wood chips with strong caustic or acid solutions, contains knots, slivers and possibly fragments of

the cooking vessel's cement lining. Specially designed units pump this mixture, which looks like lumpy oatmeal, to screens which sieve out the foreign material. Other pumps pick up the screened stock and pass it along through various refining and beating processes which prepare the fibers for conversion into paper.

Cameron has been intimately associated with the development of the modern paper mill since 1922, when the company received an order for about 60 pumps for a plant in Canada. Today, nearly all mills in the Dominion use Cameron pumps for all or some of their operations. Papermaking in Canada is confined mostly to newsprint, which is a combination of mechanical and chemical pulps, while production in the United States is largely given over to the so-called chemical stocks, which include book and writing paper, wrapping tissue and other products. The industry received a great impetus in the southern states when Dr. Charles H. Herty developed a method of making newsprint and good white paper from slash pine, and today pulp and paper manufacture is one of the South's largest industries.

Paper machines have reached huge proportions and are capable of producing up to 550 tons per day. They can run a continuous sheet of kraft 236 inches wide (that's nearly 20 feet) at the rate of 1500 feet a minute. When operating at that speed the machine requires a virtual river of stock, which is pumped at a consistency of approximately ¼ of 1 percent, but varies in accordance with the weight of the paper being made. The pumps used in this service are called fan pumps, and some of them supply 40,000 gpm of pulp against a head of 30 feet. Each is driven by a 400-hp motor through a magnetic coupling by which the speed of the pump may be varied to control the quantity of stock fed to the machine.

In the field of mine drainage, the name Cameron has been synonymous with good pumps since 1860. Mine unwatering necessitates raising seepage from the lowest level to the surface. There is no particular difficulty involved in designing such pumps unless the water is corrosive, and then it is a matter of importance that the correct materials enter into their construction. Every mine represents a different pumping problem. Some need pumps of small capacity and high head; others, units of large capacity and low head. Well-nigh the entire Cameron line can be adapted for mine pumping.

A power plant on a ship serves the same general purpose as a powerhouse on land but space is at a premium in the case of the former and the various pumps must be compact and their weight kept at a minimum. Cameron pumps have been used on shipboard from the days of the Twenty-Third Street plant in New York, and since the company started building centrifugals for marine application it has become one of the largest manufacturers of this class of equipment. Its boiler-feed pumps are on such mighty battleships as the U.S.S. *Missouri*, *New Jersey*, *Iowa*, *Wisconsin*, *Illinois* and *Kentucky*; on the *Santa Paula* and the other racy-looking passenger vessels of the Grace Line; as well as aboard the workhorses of the seas, the Victory Ships, and large tankers operated by oil companies. Aside from the main- and port-boiler feed pumps, ships have main- and auxiliary-condenser circulating pumps, fire pumps which are also used to clean tanks, and cargo pumps.

Perhaps one of the most spectacular of the marine pumps is the cargo pump for tankers. It has been said that these vessels were the life line of our Armed Forces in Europe, Africa and the Pacific during World War II when approximately 70 per cent of all the gasoline and fuel oil used to fly our bombers, drive our tanks and propel our naval vessels passed through Cameron pumps.

REDESIGNED TYPES

The lower unit is one of a line of small single-stage double-suction pumps for general hydraulic service up to 2100 gpm and 150 psi pressure. The series has permanently lubricated ball bearings and double mechanical shaft seals in place of the usual packed stuffing boxes. The other unit is a horizontally split multi-stage pump for boiler-feed and general application where the pressure does not exceed 800 psi. It features a cylindrical-bore casing, a unit-type rotor assembly, impellers in opposed groups to neutralize axial thrust, and multiple-volute fluid passages. Both pumps are more efficient than the earlier models because of the improvements in design.

Sinking a Slope by Novel Means

A Combination Slide Ramp Loader and Drill-boom Jumbo Pays Off

DRILLER-LOADER AT WORK

1, The forward end of the jumbo with the booms in drilling position.

2, The 46-inch-wide slusher ramp at the discharge end of the carriage.

3, Close view of two of the four clamps that hold the driller-loader on the track.

4, The foot brackets suspended from the booms give the driller a firm support, as this picture shows.

5, The scraper on its way to the unloading ramp through which the muck drops into mine cars for removal. The hoist that pulls the scraper up the incline is on top of the jumbo.

BACK in 1770 or 1771, Pennsylvania settler Obadiah Gore fired his blacksmith forge with some hard, carboniferous material that outcropped profusely in his vicinity. It proved to be good fuel for the purpose, and thus the American anthracite industry was born. Since that incident miners have taken about five billion tons of hard coal from the pitching, folding seams in an area of some 500 square miles that makes up the eastern Pennsylvania hard-coal region. Estimates indicate that the remaining reserves are sufficient for well over 100 years of production at the present rate.

The "easy" coal was naturally mined first, and now, to work the underground and strip mines economically, the ingenuity of the coal miner and the equipment designer is being drawn upon heavily. The evolution of mining methods and machinery in that area is an interesting and noteworthy chapter in the story of the nation's industrial growth, but we are concerned here only with a recent refinement in slope-mining practices that bespeaks a high order of mechanization.

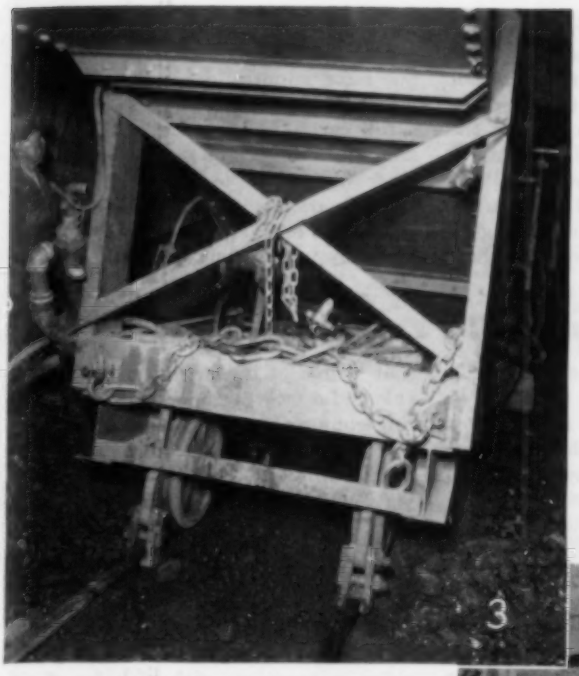
From practical experience the hard-coal miner knows that mining operations conducted on a slope are, roughly, twice as difficult and costly as those where the work is proceeding on a level. Hence, the sinking of a 600-foot interlevel slope is no small undertaking. Tancredi, Delanzo & Company, a firm made up of veteran anthracite-production and development men, has tackled such a job at the Locust No. 2 Mine near Shenandoah and has taken measured steps to insure the success of the operation. The 12-foot-wide, 10-foot-high slope that will give access to lower coal reserves is being driven on a 26° gradient through the tough sandstones and slates and flint-hard conglomerate separating the seams. It is essentially a hard-rock job.

To conduct a successful slope-sinking operation in the hard-coal region, with its inherent hazards, it is necessary to take advantage of every available time- and money-saving device and still provide maximum safety for men and equipment. Although column drilling and hand mucking are still being practiced in slope mining in other anthracite workings, they are painfully slow and therefore often uneconomical. Teaming up column drilling and slusher-slide loading has been advocated by many in recent years, but progressive men frown upon the time consumed in shifting, setting up and taking down the drilling equipment between blasts.

Why not combine drilling and loading equipment required for slope sinking and make it completely self-contained? Then the slope hoist would have but one unit to raise and lower — men would have everything they needed at all times for the full sequence of operations at the face and the working crew would be smaller because drill runners, powdermen, slusher-hoist operators and helpers could alternate duties between drilling, blasting and loading out the rock or coal. With this though in mind the combined slide ramp loader and drill-boom jumbo was conceived.

Tancredi, Delanzo & Company commissioned W. H. Landsidle of Scranton, Pa., to design and build such a machine. Its trial in the winter of 1951-52 led to the construction of a larger unit that replaced the original one early in March and that is speeding up slope sinking appreciably. The first machine is back in Scranton, and its owners are seriously considering having Landsidle mount it on a caterpillar for flat-seam operations.

The slide ramp loader and drill-boom jumbo now in use is 36 feet long from the end of the booms to the end of the discharge ramp. View No. 1 shows it backed up in the slope a safe distance away from the blasting area with booms



extended for the convenience of the photographer. The boom bases are installed one foot behind the loading apron and are spaced 5½ feet apart to permit the drills to reach every part of the face. Ingersoll-Rand Powerfeed drifters on 48-inch-feed steel shells are mounted on the 6-foot booms. Suspended from the latter are brackets that serve as foot rests for the drill runners when putting in breast and back holes. They are swung 180° over the booms and locked there with through bolts when not in service. The scraper is seen nestled under the hoist on top of the unit, and the loading apron, which is slotted to fit over the rails when lowered, is pulled up and holds the two retracted guide skirts in position. The double-drum air hoist is of the I-R Utility type and has a rated cable pull of 2475 pounds at 200 feet per minute with 80 psi pressure.

The approximate weight of the complete assembly is 12,000 pounds made up roughly as follows: trucks, chassis and framework, 8000 pounds; hoist, 2000 pounds; booms, drills, accessory machinery and equipment, 1000 pounds; and scraper, 1000 pounds. It is carried on heavy-duty trucks on a 30-inch-gauge track.

From the discharge or scraper ramp, Picture No. 2, the muck drops into cars run beneath it. They are 5¾ feet high and have a capacity of 139 cubic feet. The ramp is 14 feet long and has an inside width of 46 inches to accommodate the 44-inch-wide scraper. Notice the double tail-pulley arrangement that gives a direct pull on the drums and prevents the ⅝-inch hoisting cable from fouling on the scraper when it is in the ramp. Should an application require the loader operator to stand left of the machine (his station is normally at the right), the hoisting unit can be turned end for end and the outside 10-inch tail sheave moved to that side. The large bed between the trucks and ramp is for the storage of accessory equipment such as tools, detachable bits, and the Jackhamer used in drilling holes in the face for the pull-back sheave anchor bolts. Two Oil-IR air-line lubricators are provided for drill and hoist lubrication.

To securely hold the loader-driller on the track, an ingenious clamping arrangement was devised, as seen in View No. 3. Positioned about a foot behind the front wheels is another pair of clamps, one of which can be seen under the loader. The removal of the top bolts of these clamps collapses them, releasing their grip on the rails. Chuck wrenches provided with the drills mounted on the jumbo fit the nuts, thus reducing the number of tools needed to run the rig. One of two Ingersoll-Rand air-operated sump pumps, that are always kept in readiness to handle water at the face, is hanging from a hook on the left discharge-ramp support. The large chain attached to eyes on the sides of the frame is connected to the slope hoisting cable, or to a car at the end of the cable, when the assembly is to be moved.

Illustration No. 4 shows a worker drilling a rib hole and demonstrating the practicability of the bracket steps. The normal sequence of operations, which involves drilling 30 holes 6 feet deep in the face and charging and firing them, takes from 3½ to 4½ hours. After allowing about an hour for clearing away the smoke with the aid of a blower and a vent-tube line, the loader-driller is lowered into mucking position. Anchor-bolt holes are drilled at the center and near each rib in the breast of the face for the 8-inch pull-back sheave, and a car is spotted under the ramp

by the slope hoist. The mucking apron is dropped down over the rails to complete the incline section, which, minus the apron, is constructed on a 25° slope and has a length of 17 feet. This grade plus that of the shaft give a hoisting lift of 51°. It is well illustrated in View No. 5, which shows the loaded scraper just after it has been pulled over the apron and past the ends of the ramp frame to which the guide skirts are hinged.

There is ample clearance for large boulders on the ramp, the tightest spot being the 30-inch space between the bottom of it and the lower edge of the hoist frame. Curved rail sections, 2 feet long and hooked downward 90° for 18 inches, make up the end of the track to prevent the scraper from fouling at that point. A car containing slightly more than 5½ tons is usually loaded in seven to eight minutes, and it takes a few more minutes, depending upon the lengthening hoisting distance, to raise a full car to the surface and lower an empty. From eight to twelve scraper loads fill a car, and the removal of twelve carloads from the face usually clears the area sufficiently to put the assembly into drilling position.

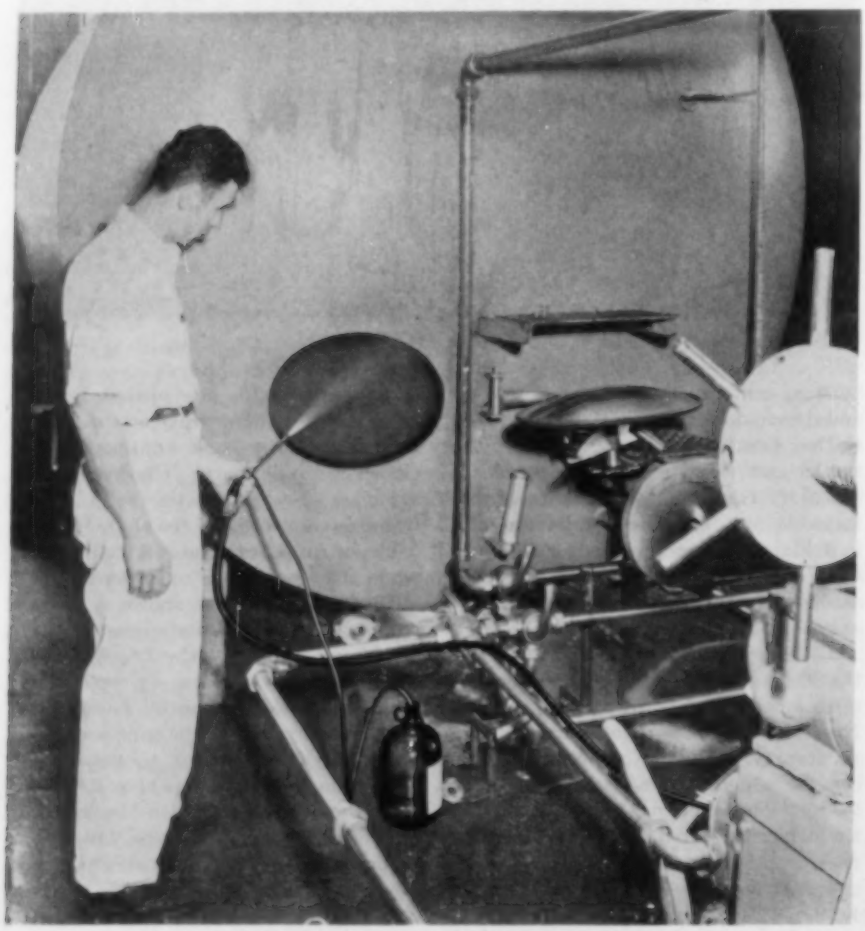
Spray Gun for Sterilizing Milk Tanks

A GUN that uses compressed air to spray a chlorine solution or other sterilizing agent into milk-holding tanks and other dairy equipment has been developed by Lonn Manufacturing Company, Inc., 131 East New York Street, Indianapolis 6, Ind. Called the Alspray Chlorine Fog Gun, it will sterilize the inner walls of the average tank in one minute and consume only about 15 cubic feet of compressed air in doing that work.

As illustrated, the spray is introduced into a tank through an opening in the end, but it is not necessary to direct it towards every part of the interior because the atomized liquid creates a billowing cloud that penetrates the entire space. As the mist condenses, a uniform film of the solution is deposited on all surfaces.

The flow of air to the gun siphons the sterilizing liquid through a Neoprene hose from any open container—a special one is not required. The control valve on the Alspray is completely enclosed and there are no buttons, plungers or springs to catch dirt. The fineness of the fog depends upon the air pressure. A pressure of 40 psi will operate the gun, and some dairies are satisfied with 50 psi, but from 70 to 90 psi will create a fog that hangs in the air long enough to spread to all parts of a tank.

In passing through the gun and mixing with the solution the air is sterilized and can therefore be taken from any source of supply. At the same time, air that is free of lubricating oil is preferable and can be obtained from a carbonring compressor like those that furnish many dairies with uncontaminated air for agitating milk in holding and weighing tanks. The same oil-free air can be used to advantage in place of mechanical pumps for transferring milk from tank trucks, to blow residue milk from tubes of coolers, as well as to operate bottle-capping machines and automatic controls without danger of clogging precision instruments with globules of oil. For the spray service alone, a 1-hp compressor with a 60-gallon air receiver will be adequate.



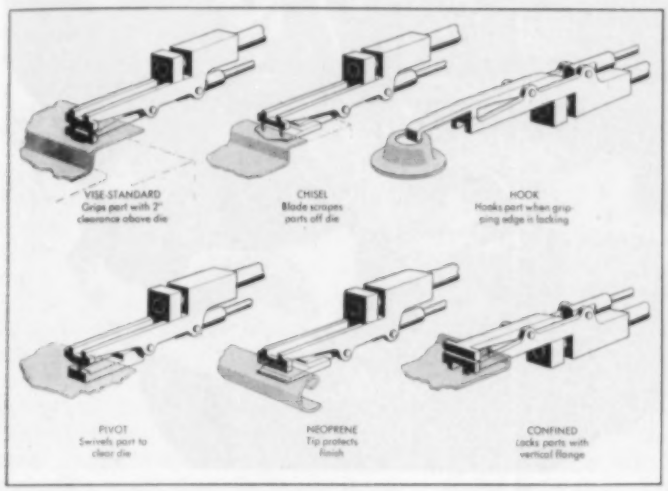
STERILIZING IS EASY BY THE SPRAY METHOD

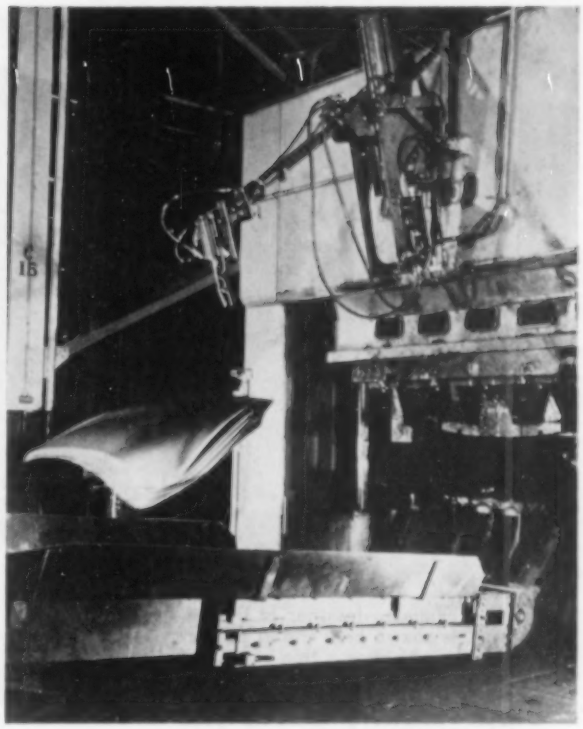
Froth Destruction

In recovering valuable mineral constituents from ores by the froth flotation method, the froth produced is often stiff and lasting. A great deal of research was conducted before magic bubbles of froth were developed that would do the work efficiently. And now, because tough flotation froth can be detrimental in subsequent filtering, dewatering and chemically treating the products it has helped to win from the ores, the laboratory man is bent on destroying it immediately after it has performed its job of selective separation. Shiou-Chuan Sun, assistant professor of mineral preparation of Pennsylvania State College, has succeeded in doing that with high-frequency sound.

With a powerful high-frequency siren consisting of a rotor that interrupts streams of air passing through orifices in a stator, Professor Sun reflected and focused the sound waves from the siren, set at a frequency of 7 kilocycles per second, into froth in a soundproof cabinet charged with compressed air at 30 psi. The immediate dissipation of the froth that followed is attributed to the periodically collapsing force of the propagated sound waves and to the induced resonant vibration of the bubbles. The experiments indicate that the sonic wind and the heat of the siren tend to increase the destructive action. It is reported that industrial froth destructors based on this principle can easily be installed to operate without interruption on frothy products as they flow from flotation machines.

Pneumatic Press Unloader with Facile Fingers





IRON HAND AT WORK

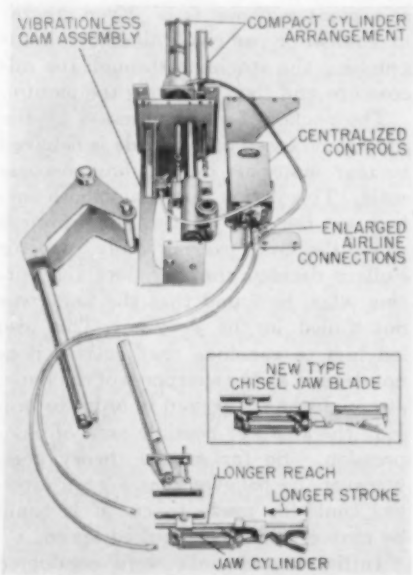
Shown here is a Sahlin unloader mounted on the front of a large press which is turning out automobile deck lids. The Iron Hand is fully extended and has just released a stamping which is dropping on to a traveling conveyor. The press is provided with a safety limit switch to stop it in case the jaws do not retract through failure of the air supply. The steel jaws have a vise-type grip, two on the lower and two on the upper section, and are strong enough to hold work weighing as much as 100 pounds, yet sufficiently facile to pick up a coin.

JAWS FOR ALL NEEDS

FIVE years ago, Henry Sahlin invented the Iron Hand, a self-contained counterpart of the human arm which has made a place for itself in industry because of the facility with which it picks up work as it comes from machines and deposits it for removal to the next processing stage. Lately, its field of usefulness has been increased because it has been given six metal jaws to handle an endless variety of parts formed by medium- and large-size automatic presses especially in the domestic-appliance and automotive industries where assembly-line methods have been highly developed. They are also suitable for use in connection with welding machines, shears and brakes.

The Iron Hand, as an accompanying illustration shows, is operated by two air cylinders—a main power or lift cylinder and a cylinder for opening and closing the jaws. It is available in three models (large, standard and junior) that can pick up anything, it is claimed, from a 1-ounce coin to a 100-pound freight-car section. The smallest size works on pressures as low as 45 psi, while the others use air at 60-80 psi, depending upon the dimensions and weight of the parts handled.

Synchronized through the medium of a limit switch with the movement of the machine on which it is mounted, the robot arm becomes active when the ram descends and completes the forming or shearing cycle, causing the jaws to reach into the die and grip or take hold of the workpiece the instant the ram begins its return stroke. Then it lifts the part out of the die, swings it back, places or drops



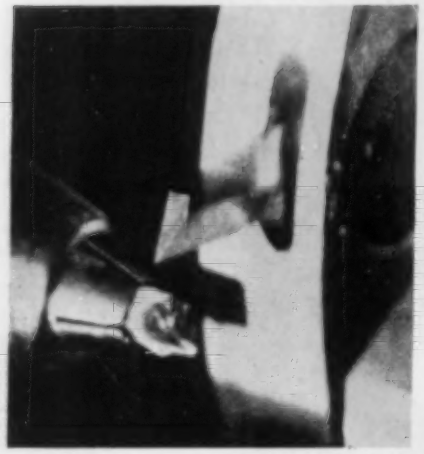
UNLOADER ASSEMBLY

it on a table or conveyor, either side up, and resumes its initial position to repeat the performance. The junior Iron Hand operates at the rate of twenty strokes per minute, and the larger sizes at twelve to fifteen per minute.

The jaws differ widely in design so as to grip nearly every kind of stamping or part regardless of shape or dimensions. There are two basic types—the vise and chisel grip—which meet the requirements of most unloading conditions. The first-named takes hold of work raised 2 inches or more above the surface of the die, while the second digs under a part resting on the die. The four others are specialty jaws: a hook type for stampings which have no gripping edge but have a pierced section or hole, as in the case of some barrel heads; a jaw tipped with neoprene to protect work with special finishes; a pivot type which moves laterally to clear tight die areas; and a jaw which confines—does not grip—sections with flanges to avoid crushing the latter. All are adjustable in and out for parts of varying widths and up and down for different loading heights, as well as for angle of travel into the die and upward movement before swinging out. The arm, itself, is of the telescoping type and can be locked in the "up" position when loading or working on dies.

Since the Iron Hand was introduced, many have been installed in mass-production plants. It is claimed that they make it possible to take advantage of full press capacity, with a resultant increase in production of as much as 30 percent. In addition, by relieving men of the dangerous job of handling often heavy and sharp-edged stampings, the likelihood of accidents has been greatly minimized.

Cutting with Wind



TOO THIN TO SEE

Dr. E. F. Fullam, designer of the microtome, is shown here (right) preparing to use it to slice a thin section of copper wire for study under an electron microscope. The knife is projecting from the wheel that gives it a top speed of 818 miles per hour. Submicroscopic sections, too thin for the eye to see, are caught in a glass jar. When the instrument is in operation, the raised visor is lowered over the revolving wheel. Above, the knife is pictured traveling at supersonic speed. The material being cut is wax, in which specimens of other substances are to be embedded for further study.

EXTREMELY thin slices of various substances ranging from asbestos to zinc are being cut in about a dozen American research laboratories with a knife that whirls at high speed. That is, a knife is used, but the actual cutting is done, it is believed, by a small pocket of air that is compressed immediately ahead of the speeding blade. Incredible as this may sound, it is the conclusion reached by Dr. E. F. Fullam, General Electric Company Research Laboratory microscopist who invented the slicer.

Called the microtome, the machine consists essentially of a knife mounted on the perimeter of a wheel, 3⅜ inches in diameter, that is connected with a ⅓-hp "souped-up" driving motor. At full speed the wheel makes 65,000 rpm, and the tip of the knife blade travels 1200 feet per second, which is equivalent to 818 miles per hour, as against 750, the speed of sound.

The microtome is utilized to provide sections for examination under the electron microscope. According to Doctor Fullam, it has produced a shaving of metal only two-millionths of an inch thick, or about one-thousandth the diameter of a human hair. Such a section is invisible to the naked eye. Under the microscope, it is thrown up about 25,000 times, at which magnification a human hair would appear to be as large as a giant redwood tree. Even greater magnification can be obtained by photographing the specimen through the microscope and then enlarging the picture.

The pocket of air compressed by the supersonic speed of the blade is believed to tear materials on a submicroscopic scale. This action leaves a smooth surface on the face of the cut, through which the knife passes readily. Doctor Fullam decided that air does the cutting when he found that the knife was not dulled in the process. This also led him to conclude that cutting does not depend on the sharpness of the knife, although that is desired in order to provide the smallest possible area of compression. So far as the theory goes, however, he believes that even a crowbar could be made to cut if it could be moved with the required speed.

Initial experiments were conducted with a razor blade as the slicer. It was chosen not for its sharpness but because the fine edge was suitable for building up compression along an ultrathin path. The blade now utilized is especially made, and Doctor Fullam occasionally sharpens it manually because the keener the edge the smaller the cut. He has even used a thin wire. Centrifugal force produced by the whirling wheel tends to stiffen the wire, he says. In fact, he declares that a wire that is barely visible to the unaided eye will, when traveling at high speed, become as stiff as a steel bar 1/16 inch in diameter.

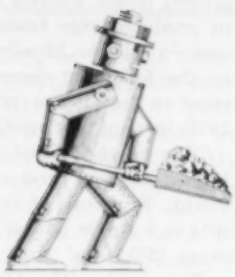
The samples that are sliced are necessarily of small size, with the upper limit about the thickness of a lead pencil. The specimen enters the knife's path from the side, the motion being likened to that of the machine butchers use to slice sausage or cheese. No cutting noise is heard, which bears out the theory that air and not the knife does the work. Only the motor's shrill hum is audible.

Among the materials sliced by the microtome in the G-E laboratory are cork, bone, mica insulation, metals of different kinds, wood and plastics. The instrument will not successfully cut rubber or vitallium, the latter an extremely hard metal. It would slice rubber if the latter were frozen or vulcanized to a more brittle state, Doctor Fullam says. He adds that the hard metal could also be cut if the wheel could be rotated faster so as to compress the air to a higher degree.

New Distance Calculator

AN ELECTRONIC machine that calculates geodetic distances with great accuracy has been developed in Europe. Called the Geodimeter, it is based on principles that were used in 1849 by the French scientist Fizeans for calculating the speed of light. To measure the distance between two points, a mirror is placed at one and the Geodimeter at the other. When light reflected from the mirror is refracted into a receiver in the instrument, the distance can be read off on a scale. It is claimed that the method is accurate to within 1.8 inch in 7 miles. Because of its precision, scientists have revised their conception of the speed of light from the usually accepted figure of 186,271 miles per second to 186,282 miles, with a possible slight deviation. A Swedish firm is manufacturing the Geodimeter and has sold its output far in advance.

Pneumatic Fireman Does Good Job



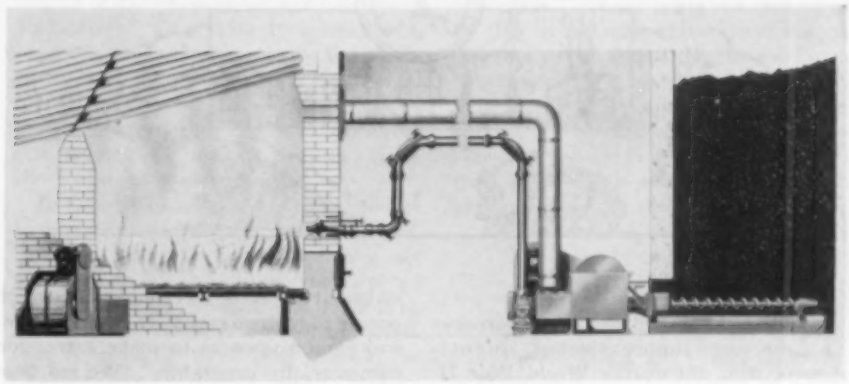
A current of air has replaced the shovel that graces a familiar trademark.

AS ITS name implies, the Iron Fireman Pneumatic Spreader stoker feeds coal to the furnace of an industrial boiler plant in a stream of air. Its widespread use bears out the claim of its maker that it offers numerous advantages.

The system is completely automatic. A worm or screw-type conveyor moves the coal from either a hopper or a bunker to a transfer housing, where it is picked up by air mixed with hot gases from the furnace and carried into the burning zone. There the fuel is discharged through a nozzle that distributes it uniformly over the entire grate surface. The nozzle has a hinged end section so it can be elevated to give it the required throw and is fitted with a deflector wedge to regulate lateral distribution. The preheated fines burn in suspension and the larger pieces fall to form a shallow bed on the grate.

The high-temperature gaseous conveying stream provides overfire air, an essential to efficient combustion. At the same time, cold air introduced underneath the grate rises through the fuel bed and meets the coal-carrying current at right angles. This produces maximum turbulence, another requisite to good combustion and elimination of smoke. The undergrate air supply is controlled by a volumeter in accordance with the thickness of the fuel bed. The rising air keeps the temperature of the grate below the fusion point of the ash falling on it, with the result that no heavy clinker is formed. The conveying medium is placed under pressure by an enclosed radial-vane fan driven by an electric motor. The proportion of hot combustion gases introduced from the furnace can be regulated as desired or eliminated and air alone used.

Units are available with capacities for feeding from 1600 to 4000 tons of coal per hour, and multiple stokers can be provided for handling larger quantities. They are designed to burn lignite and all grades of bituminous coal economically. The fuel is ordered in so-called steam sizes, but a crusher section in the worm feeding mechanism reduces any oversize pieces present. By controlling the worm speed the coal is metered to meet steam requirements. As a result of this and other features, it is claimed that the system will produce steam of uniform pressure regardless of fluctuations in demand. The equipment is made by the Iron Fireman Manufacturing Company, of Cleveland, Ohio, which is well known also for its furnace stokers for home heating.



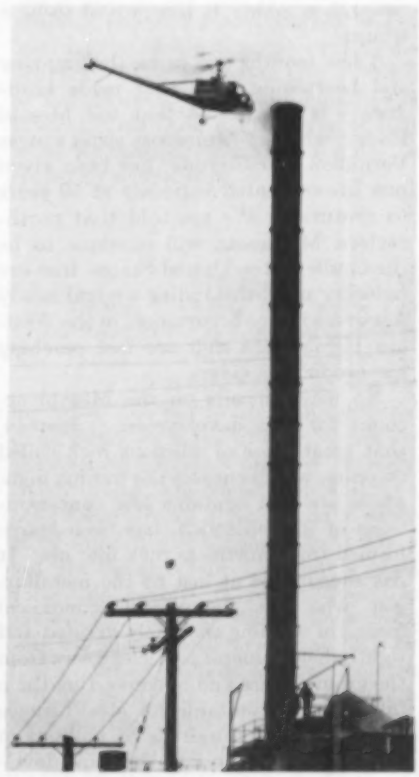
FEEDING THE FLAMES

Section through an Iron Fireman Pneumatic Spreader stoker. Starting at the right, the coal is moved by a screw conveyor to a transfer housing, where it is picked up in a stream of air mixed with hot combustion gases from the furnace. The coal is discharged into the firebox by a nozzle that distributes it evenly. Air rising through the grate meets the fuel and produces a turbulence that makes for efficient combustion. It also prevents the formation of heavy clinker.

Electronic Devices in Role of Detective

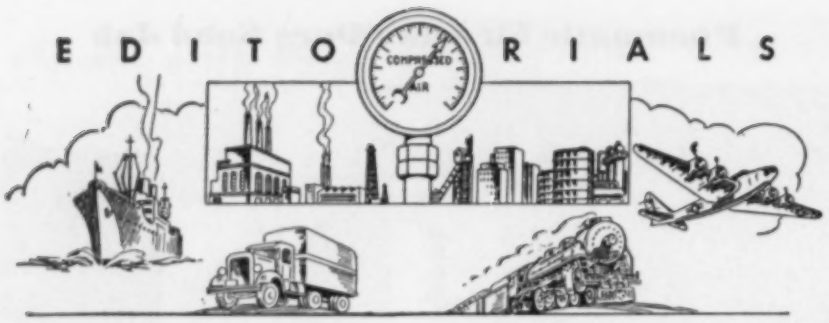
BY THE use of electronic equipment in a large southwestern gas-processing plant it has been possible, according to Burgess-Manning engineers, to determine the cause of pulsations and noise in compressor piping and then to correct the trouble. It was localized in one section of the plant and involved four 4-stage machines each of which has three double-acting compression cylinders and one single-acting cylinder. Operating speeds vary from 250 to 300 rpm. The four units have common suction and discharge headers, and each has its own intercooling and aftercooling system.

The electronic equipment consisted of a pressure pickup (transducer), amplifier and oscilloscope. The transducer, which was coupled as closely as possible to the gas stream, generates a voltage for a given pressure change and faithfully reproduced the pressure changes in the pipe in voltage, which was conducted to a 3-stage amplifier and then to the oscilloscope screen where photographic records were taken of the surge. Its amplitude was measured on a screen, and calibrated voltage was developed to effect an equal amplitude deflection. The maximum peak pressure change was then calculated from the known data. The source of the pulsations and noise that resulted in vibration and line breakage was thus traced to the piping between several compression stages in two machines. These were provided with gas snubbers which, according to the company, have eliminated the difficulty.



HANDY HELICOPTER

Whenever the 150-foot stack at the Everett, Mass., plant of Monsanto Chemical Company had to be painted, it used to take a day and a half to rig up for the job. Working from a helicopter chartered from the East Coast Aviation Company, George F. Burgess recently affixed a hook to the top of the chimney and unreeled lines to the base. Including flying time, the machine was in the air 30 minutes.



ROCK BECOMES ORE

HUNGRY American steel furnaces devoured unprecedented quantities of iron ore during World War II, and the high-grade direct-shipping deposits of the Minnesota iron ranges were threatened with depletion. Although iron and steel men had long foreseen the decline of the mighty Mesabi that has for years been the world's most productive iron-ore region, there seemed to be no replacement reserves available for development. Where would they go for the ore for the ever-expanding steel industry? Were the iron ranges of Minnesota really entering their last few years of productivity? To forestall such an eventuality they decided on a $40-million research gamble. It has proved to be a winner!

A few months ago came the amazing and heartening news that made headlines. It assures us that the Mesabi Range, with her Minnesota sister ranges Vermilion and Cuyuna, has been given new life estimated variously at 50 years to centuries. We are told that northeastern Minnesota will continue to be the cradle of the United States' iron-ore industry notwithstanding several newly discovered large occurrences in the Western Hemisphere that are fast reaching the production stage.

No new deposits on the Mesabi account for this development. Instead, that great mass of siliceous rock called taconite, which encases the waning high-grade ore and contains low concentrations of iron minerals, has been transformed from worthless rock into ore. It has succumbed at last to the metallurgist who has discovered economical means of winning the finely divided and tightly held mineral particles away from the ground mass and of converting them into products suitable for steel-furnace consumption. Hundreds of millions of dollars are pouring into the mine-development and plant-construction programs that will keep the pulse of the Mesabi Range beating.

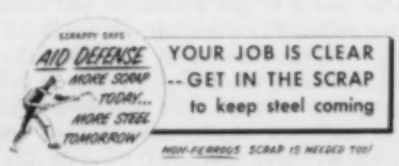
This is but another example of the fine line often existing between rock and ore in Nature's mineral storehouse. That boundary may be better visualized if we read Robert Peele's generally accepted definition of ore: "Ore is a mineral, or mineral aggregate, containing precious or useful metals or metalloids, and which occurs in such quantity, grade and chemical combination as to make extraction commercially profitable." We see then that the division between the rock and ore of a mineral occurrence is based on several factors that may be restated to more closely parallel the point we wish to make. The grade and continuity of the mineral or mineral aggregate; its amenability to metallurgical processes; the costs of mining, transportation, concentration and refining are on one side of the ledger and must be weighed and balanced against the demand for the end product which is reflected in its price. Taconite did not fit that definition until about a year ago. The extraction of its useful constituent was not commercially profitable at that time. It was worthless rock—not even low-grade ore.

Today, as a result of the long strides in metallurgical technique, teamed with advances in open-pit mining equipment and methods, taconite is ore; that is, a great quantity of the Minnesota and some Michigan taconite, which contains about 25-30 percent iron, now fits the definition of ore. And those deposits contain much more steel-furnace food than has been won from the high-grade and the easily concentrated low-grade ores since the initial discovery of iron in the area in 1884.

With this development and the preparation for large-scale production, the Mesabi becomes the proving ground for mineral beneficiation plants of gigantic proportions and unique design. For example, a crusher being built by Allis-Chalmers Manufacturing Company for one of the enterprises will stand four stories high and weigh 625 tons. It will crush hourly 3500 tons of the flint-hard ore with power supplied by two 500-hp motors.

And the range will continue to be the testing laboratory for open-pit mining machinery such as Quarrymaster blast-hole drills, 50-ton dump trucks and improved power shovels that are designed to produce large tonnages at low unit cost—a role the Mesabi has long played, as the following excerpt from a statement on the back cover of the December, 1920, issue of this publication brings out:

"Up on the Mesabi range exists the largest iron ore producing section of the world. From one of its immense iron ore pits in a single period of operation covering 200 days' time was shipped ten million tons. The Oliver Iron Mining Co. has taken as much as 28 million tons from its group of properties in a single year. This mining district blazed the way for the Panama Canal, a world-famed achievement in the annals of engineering, as the methods developed on the Mesabi range were adopted and were finally responsible for the successful completion of the Canal."



WHAT IS A FARM?

THAT question is being asked by innumerable Americans who normally have no interest in the subject. In many instances, factory workers, city office personnel, families from all walks of life have chosen to move away from urban boundaries into country surroundings where they have, sometimes without planting a seed or hatching a chick, become farmers by classification.

Technically, many of those who have been put in that category in recent years really don't belong there. They made their homes on tracts of land that once were producing farms, and the reclassifying of property is ofttimes a slow process. However, those who wish to satisfy themselves as to their official status can turn for the answer to the 1950 Census of Agriculture. It classes as a farm any place of three or more acres which, in 1949, yielded crops, exclusive of home-garden produce, valued at $150 and more. Areas less than three acres in extent are called farms only if they sold $150 worth of agricultural products. Note the distinction between products produced and sold.

That definition differs from the one in the 1940 and 1945 censuses, according to which a plot of three acres or more was counted a farm if it provided anything other than the small home-garden variety of produce during the year preceding the census, while one of less than three acres was considered a farm if its crops were valued at $250 or more. That change in classification alone reduced the number of farms between 1945 and 1950 by possibly 200,000 and put the suburban nonfarming dwellers involved under another head, at least so far as the national census was concerned. City, county, and state records may, however, lag considerably behind the census, so you may be a farmer in one case and not a farmer in the other. So, what is a farm?

This and That

Migrant Blast Furnace

Back in 1904 an 85-foot blast furnace, with an annual capacity of 75,000 tons of pig iron, was built at Battelle, Ala., about 40 miles from Chattanooga, Tenn. After a few years of service it was shut down and remained inoperative for eleven years, when a steel company in India decided to buy it to meet the demand for steel rails in Mesopotamia during the first World War. The structure was dismantled in 1917, transported by rail to New Orleans, and then put aboard a steamship for the 16,000-mile run to Calcutta around the Cape of Good Hope. From there it was carried another 155 miles by rail to Jamshedpur, where it was set up by the same men who had dismantled it. Exactly two years to the day when the latter work was begun the blast furnace was in production in India. It was recently relined.

* * *

Power from the Arctic

A new chapter in the history of power transmission was written on March 31 when, after four years of preliminary work, Sweden's new steel-aluminum 380,000-volt supertension cable extending from the Harspranget power plant above the Arctic Circle to Hallsberg in the central part of the country, was put in service. The line is 600 miles long and is said to be the first of its kind in the world. Details about its construction have not been revealed, but it requires less material than ordinary cable and is said to carry its load with a considerable reduction in power loss. The State Power Board plans to use lines of this type to transmit current from all stations to be built in northern Sweden and estimates that six or seven can take care of all future power needs, as against 30 if the older 220,000-volt cables were used. Three 100,000-kw turbogenerators are installed in the Harspranget powerhouse, and their combined output of 1,800,000,000 kw-hrs represents about one-tenth of the country's total production.

* * *

Covered Bridge Notes

The nation's large but dwindling group of covered bridges was recently reduced by two when California replaced the last pair in its state highway system with conventional steel-and-concrete spans. There are still several in the state's county road system. The structures removed were not old, having been built by the U.S. Bureau of Public Roads in 1921 and 1922, and were not in poor condition, as was demonstrated when the first charge of dynamite failed to bring one of them down. They were done away with because they were too narrow for 2-way traffic and too weak to carry full legal loads. Being on a highway that follows the upper reaches of the Klamath River into mining and logging country, those shortcomings were serious.

In Massachusetts, where the people have a deep affection for covered bridges, two old ones are currently being replaced, but by structures that are as nearly like the originals as it is possible to make them. When it became apparent that a crossing over Mill Brook, in Charlemont, Franklin County, was in bad condition, the town officials were loathe to part with it. So that they would

be sure of getting a similar span, they offered to defray a part of the cost provided the State Department of Public Works would respect their wishes. The offer was made after the voters, in special town meeting, had approved the appropriation of funds.

The new bridge, the first covered one built in the state in 45 years, is 94 feet long and has a 24-foot roadway. The matched-board sides and shingled roof were treated with creosote to give the illusion of age. The structure cost $49,000. At Sheffield, on the Housatonic River, a 135-foot span is being constructed of stained timbers and rough stone masonry to make it look like its 1835 predecessor, which was probably the state's oldest covered bridge. Thirteen others in Massachusetts are still in service.

* * *

Pneumatic Gadgets for Motorists

Several pneumatic appliances for automobiles have recently appeared on the market. Hush Bumpers, Inc., of Chicago, Ill., offers inflated bumper guards for passenger cars that are claimed to "take the bump out of the bumpers." Made of molded rubber or polyvinyl chloride, they are said to be resistant to wear, abrasion, water, ice, sunlight and detergents. They not only absorb shock but also afford protection against scratches and dents.

For insertion in the coil-type springs of automobiles, Air Lift, of Lansing, Mich., makes cylindrical-shaped inflated bags. When a vehicle is heavily loaded, they serve as supplemental springs and shock absorbers. Air piping is run from them to the trunk compartment of the car, where a gauge shows the pressure at all times and a valve permits adding or withdrawing air according to the weight carried. We have also heard that one can now get an attachment for tire valves that will whistle a warning when the pressure drops to the danger point.

* * *

Drill Core Library

Since its opening about a year ago, the drill-core storage library which the U. S. Bureau of Mines maintains near Minneapolis, Minn., has collected 37,628 of these samples of the earth's crust from Minnesota, Wisconsin, Michigan and South Dakota. It is the only federal depository of its kind where industry can store and examine cores from mineral-exploration projects free of charge. Operators from all sections of the country are invited to make use of the facilities.

The library was built to conserve cores for future study in view of the fact that they may contain materials not sought at the time they were taken and that minerals once considered worthless may suddenly become vital to our economy. The latter was true of radioactive minerals which were found to be present in many old drill cores when they were reëxamined and could thus be traced to their source.

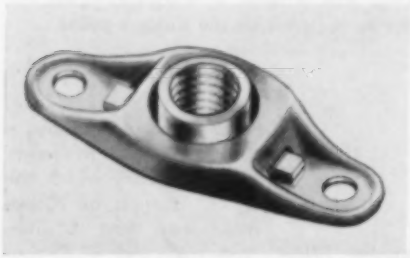
* * *

Diving for Sunken Logs

Submerged for ten years and more, logs that sank on their way to sawmills on the Pacific Coast are now being raised and put to use. This unusual underwater work is being performed by the Shelton Salvage Company by regulation diving equipment, an American hoist mounted on a barge and a series of oil-drum floats appended to it like a tail. In the area where the job is being done, the bottom of Puget Sound is covered with mud sometimes waist deep, and the diver must locate the logs by touch. When he finds one, he attaches a hook to it and notifies the surface crew, with which he is in continual communication. When the hoist has brought up the log it is attached to three of the 50-gallon drums and towed to the mill by a small boat powered by an outboard motor. By the time it reaches its destination it has been washed clean by its passage through the water and is ready for barking and conversion into pulpwood. Of the estimated two million feet of logs awaiting recovery, approximately 98 percent is hemlock, a high-grade material for papermaking.

Industrial Notes

A floating anchor nut of new design has been announced by the Kaylock Division of The Kaynar Manufacturing Company. It is a 2-part assembly which provides a radial movement of 1/16 inch between the threaded nut section and



the anchored retaining shell, both of which are made of light-gauge annealed spring steel. Among the outstanding features claimed for it by the company are: interchangeability with standard fixed anchor nuts of comparable thread size; lightweight combined with strength; elimination of an auxiliary locking device because upper threads are elliptical and permit all threads to carry the load; resistance to temperatures as high as 550°F; and good bearing qualities.

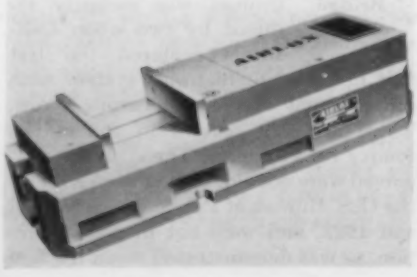
Motor vehicles or gasoline engines stalled because of some breakdown in the fuel system and even lack of gas can be started and run for short periods on an emergency ration put up by Viking Tool & Machine Corporation in a compact leak- and fireproof container. The unit, named Gas-o-lator, holds a gallon and is mounted directly on the carburetor after removal of the air cleaner. It operates independent of the fuel system.

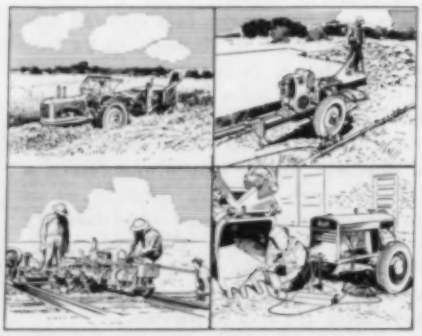
Micamat is the trade name of an electrical insulating material made of treated mica flakes and in continuous sheets ranging in thickness from 0.002 to 0.006 inch. A product of General Electric Company, it is said to be superior to machine- and hand-laid mica in dielectric strength, which can be further augmented by impregnation with resin and bonding to paper and cloth. Material can be molded into shape for insulating motors and generators and, in tape form, wrapped around bars, cables, and the like. Commercial production is to be undertaken shortly.

For finishing surfaces of machine parts that cannot be treated by conventional methods, Norton Company has designed a pneumatically operated lapping machine that makes use of a paper or cloth abrasive strip treated with a waxy lubricating compound that eliminates the need of the customary coolant system. It is mounted in 50-yard rolls at the rear of the unit and reeled, as required, on spools on lapping arms that are part of a bracket assembly which is lowered when the machine is in service. A control valve automatically governs the loading and unloading cycle, and an electric timer, adjustable from two seconds to twenty minutes, controls the finishing

operation which, in the case of the average product, usually takes from 20 to 25 seconds. Upon completion of the time cycle the machine runs in reverse, and when it comes to a stop the work is ready for removal. The No. 12 Simplex, as it is designated, was built to finish machined parts with cylindrical sections between shoulders or sections shrouded by overhanging flanges. In the accompanying illustration it is shown with a camshaft locked between the electrically run headstock at the left and the pneumatically operated footstock at the right. It will take work ranging in diameter from ½ inch to 2½ inches and up to 12 inches long.

Production Devices Incorporated has added a new model to its line of Airlox pneumatic vises. The S-7, as it is designated, features a chip plate and felt wipers that are said to reduce maintenance to a minimum. The plate rides in a slot in the vise bed and travels with the movable jaw; the felts are recessed in the movable-jaw casting and





Single cyl. 3 to 9 H.P.

2-cylinder 7 to 13 H.P.

V-type 4-cyl. 15 to 30 H.P.

WISCONSIN *Air-Cooled* ENGINES

Fit the Job and the Machine

Because Wisconsin Air-Cooled Engines are supplied in a complete power range, from 3 to 30 H.P., in 4-cycle single cylinder, 2- and 4-cylinder types, there is an ideal size to fit all types of machines and power applications within this range, without wasted power and with maximum power service benefits. Heavy-duty construction, combined with extremely compact design and light weight are added advantages—and dependable AIR-COOLING permits trouble-free service under all climatic conditions.

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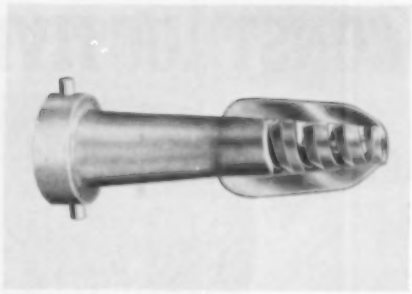
clean the bed and the fixed-jaw casting. It is claimed that chips and dirt are thus prevented from clogging the movable jaw and from getting into the vise mechanism. Another feature of the new unit are cross keyways in the faces of the jaw castings, with a dowel hole in the keyway center, for positive alignment of the false jaw faces. The S-7 grips the work with a pressure 100 times greater than that of the air by which it is operated.

Reuse of metal drums carrying dangerous commodities is permissible by authority of the Armed Services and the Bureau of Explosives if they have been tested for leakage for a period of not less than 45 seconds under prescribed pressure. For this purpose Drum Equipment Company has built an explosion-proof detector that operates on the same principle as its standard model widely used by oil, chemical and drum-reconditioning companies. By means of special plug adaptors it can be utilized to check 5-, 30- and 55-gallon containers with head or side fillers for any predetermined time cycle from 10 to 60 seconds. Compressed air at 40-100 psi from any shop source is reduced to 20-25 psi and admitted into a drum by pressing a button, which also causes a red light to glow. When a gauge on the slop-

ing top of the detector indicates that the container is under a pressure of 6 psi the operator releases the button, thus turning on a green in place of the red signal. If the drum is airtight, the green light will burn from beginning to end of the set time cycle; if it leaks, the red light will reappear. Air consumption for 55-gallon containers is at the rate of 10.5 cfm. The manufacturer claims that as many as 60 drums of the latter size can be handled in an hour. Our picture shows the standard model.

Securing machinery, pipe flanges, hand rails, seats, etc., to concrete by anchor bolts is expedited by the use of Por-Rok, a fast-setting nonshrinking cement that is said to insure a stronger bond than the concrete itself. Mixed with water it is poured cold into the drill hole in which the bolt is centered, allowing lightweight equipment to be installed in less than 30 minutes and heavy equipment within one hour. An independent testing laboratory reports that the compound, made by The Hallemite Manufacturing Company, has a compressive strength of 4500 psi.

For fighting large fires both in- and outdoors, Bete Fog Nozzle Inc. has developed a giant nozzle with a patented spiral atomizing element free from small clogging orifices or internal parts. Made of bronze with external vanes for added strength, it has a 2½-inch National Standard thread connection for direct



attachment to a hose or turret gun similarly threaded. According to the manufacturer, the new nozzle has a reach of approximately 80 feet and covers a wide area with a 500-gpm cooling fog blanket

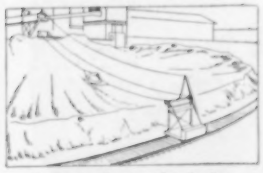
MORE YARDAGE
LESS LABOR
LARGER PROFITS

Here is a Sauerman Slackline Cableway supplying a screening plant with 225 tons of gravel an hour. Pit is 900' long 400' wide, 100' deep. Operated by one man and a 170 h.p. motor. Runs years on few repairs. Total operating cost about 5c per ton handled.

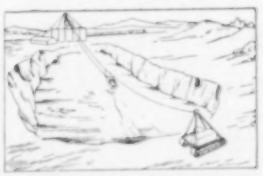
Why it pays to use

SAUERMAN EXCAVATORS

Sauerman Scraper Excavator



Sauerman Scraper Stockpiler



Sauerman Slackline Cableway

Savings in equipment cost, time, labor and maintenance are four big reasons for using Sauerman Scraper and Cableway machines for all your long range material handling work.

One-man control, fast action, simple and trouble-free. A Sauerman machine reaches across a river, deep down into a pit, up to the top of a hill or across a wide stockpile—moves material from any point within its cable radius, and dumps automatically wherever required.

Whether you handle a few tons a day, or many thousand tons, there is a size and type of Sauerman machine suited to your requirements—a machine that will give you years of steady service at minimum expense, no matter how tough the work it is called upon to do.

● **Write to us about your interests and we will send large catalog with complete data by return mail.**

SAUERMAN BROS., Inc.

548 S. Clinton St. Chicago 7, Illinois

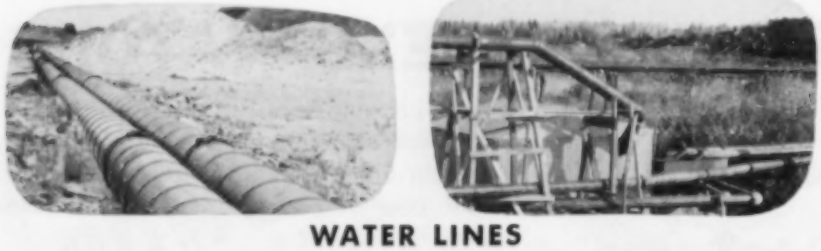
Cableway and Scraper Specialists Since 1909

CONSTRUCTIVE SUGGESTIONS

Typical Ways in Which NAYLOR Light-weight PIPE Serves Mining Engineers

TAILINGS LINES

AIR LINES



WATER LINES

HYDRAULIC LINES

Write for Naylor Bulletin No. 507

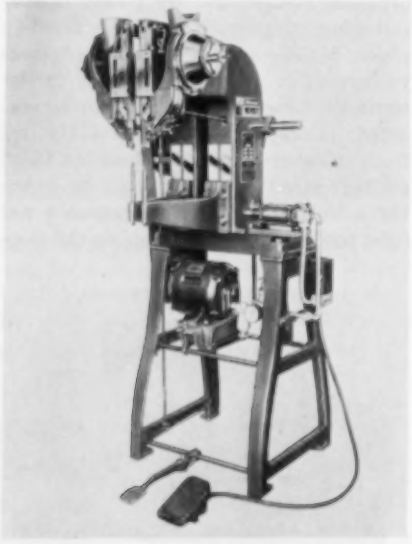
NAYLOR PIPE

Naylor Pipe Company
1245 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

which is effective even against wood, paint, and other hot fires.

Businesses, contractors and others whose activities are more or less dependent upon the weather can now obtain a monthly weather map on a yearly subscription basis. This long-range forecasting service is offered by Blewett Weather Service, Pasadena 5, Calif., at low cost. Separate charts are obtainable.

At the Metals Show held not long ago in Detroit, Mich., the Chicago Rivet & Machine Company exhibited a new machine that enables an operator to set two rivets at a time from either one of two selective, fixed centers. It is equipped with two rivet heads each of which can be quickly shifted from one position to another by a foot-controlled pneumatic cylinder using air at 15 to 20 psi, gauge pressure. In the case of an assembly with



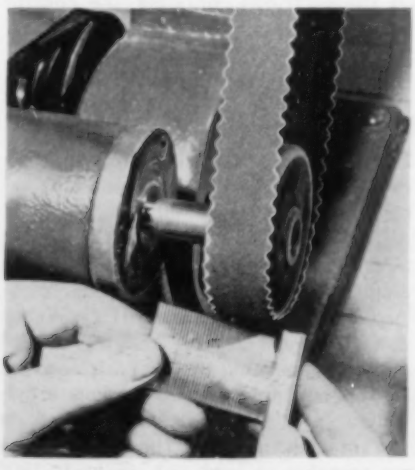
eight rivets, for example, arranged two each on opposing sides, one rivet head is moved to Center A and sets the rivets facing each other in two operations. Pressure on the pedal then centers the other head on B to set the four remaining rivets, also in two strokes. Adjustable stops permit a large selection of riveting centers from $\frac{5}{8}$ inch to $2\frac{1}{2}$ inches (standard), with a maximum of 6 inches, and a 14-inch depth of throat and long anvils make it possible to accommodate a wide range of assemblies. Rivets used have the same body diameter (9/64 inch) but vary in length (maximum $\frac{5}{8}$ inch) and are fed automatically from an interchangeable rotary-type hopper. Rivet raceways on both heads are provided with locks for single rivet setting.

Conoflow Corporation and Paul Valve Corporation have collaborated in the development of a complete line of throttling control valves combining Conoflow pneumatic-cylinder operators and Paul venturi ball valves. The assembly can

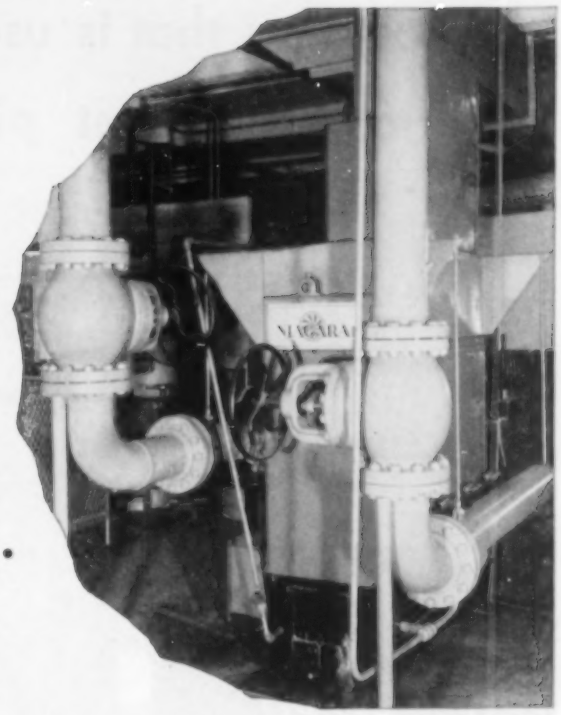
be used together with standard pneumatic instruments for automatic control or, with manual loading stations, for remote hand positioning and is said to simplify many control problems involving corrosive fluids, abrasive materials, high-temperature and pressure applications, and other similar services. The streamlined venturi passages and smooth-surfaced ball insure a nonturbulent flow that prevents cavitation, says the manufacturer, while the principle on which the ball operates reduces unbalanced forces to unusually low values so that the advantage of tight shutoff can be obtained without sacrificing control sensitivity. The valve is available in sizes up to 8 inches.

Early in January, a British expedition set out on a geological investigation of the uninhabitated sections of Sierra Leone and the Gold Coast of Africa. Using a new design of Geiger counter mounted in Land Rover vehicles, they are looking for uranium or thorium. The detecting equipment consists of eight tubes, each 30 inches long, that will automatically record the presence of the sought-for elements in the subsoil. Large concentrations will cause a buzzer to sound an alarm.

Through the use of a new abrasive belt with serrated edges, the work of precision grinding and finishing jet-turbine and compressor blades, formerly a bottleneck in jet-aircraft manufacture, is now performed in one instead of two operations. The belt, a product of the Minnesota Mining & Manufacturing Company, can be used on crowned, contoured or rounded-edge wheels, or with shaped back-up supports. In service,



How to get drier or cooler gases . . .



NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

Over 35 Years' Service in Industrial Air Engineering

Dept. CA , 405 Lexington Ave. New York 17, N. Y.

Experienced Field Engineers in Principal Cities of U. S. and Canada

The coupling that is used along America's greatest pipe lines

WALDRON
Improved
GEAR TYPE
Couplings

Where dependable, continuous operation is so essential as at the pumping stations along the thousands of miles of oil pipe lines it is significant that WALDRON Couplings were installed. Great pipe lines like the Mid-Valley, the Richfield, the Ozark and others enjoy the operating advantages of the WALDRON Coupling design and construction refinements. Forged steel parts, one piece cover sleeve, automatic lubrication, positive seal, less rotating weight and other major features combine to insure the longer life of trouble-free service that has made WALDRON couplings so popular. The most economical coupling to buy and use.

Standard basic design can be revised for special applications. Write for descriptive Catalog 57 for detailed information.

JOHN WALDRON CORP.

NEW BRUNSWICK NEW JERSEY

Sales Representatives in Principal Cities

the scallops curve around the edges of the contact wheel, thus permitting fillet areas to be polished. The belt is expected to find wide application in metalworking fields where small-radius grinding and filleting are now done separately by hand.

Analyses of petroleum products in one-tenth the time now required is possible, says the Atlantic Refining Company, by use of a combination electronic computer and mass spectrometer which records the chemical composition on paper.

Three parts—a cartridge container, a cartridge, and an air-flow check valve—make up a new valve assembly recently developed by Mine Safety Appliances Company for its air-line respirators and abrasive masks and helmets. The unit regulates the flow from a compressed-air source to an operator wearing such equipment and also serves as a secondary air filter. An adjustment knob on the cartridge case regulates the air supply and provides against reducing the flow of breathing air to less than 2 cfm. The knob cannot be changed accidentally when set. By means of a trigger on the cartridge container the control valve can be detached from the air hose, which is provided with a spring-loaded ball-type valve that automatically stops the flow of air when the hose is disconnected. The accompanying illustration shows a workman wearing a respirator equipped with the new valve assembly (right, below elbow).

To facilitate light machining such as single drilling, tapping or milling, Web-Aire Products, a division of H. G. Weber & Company, Inc., has designed a 180° rotary index table that is positioned by two opposed single-acting pneumatic cylinders. With two fixtures mounted on the rotating steel disk, the table permits an operator to load one, swing it 180°

to the machining position by an air-control valve, and unload and reload the other while work is being performed. Reversing the valve, returns the table to its original position. Air at pressures up to 200 psi can be used to actuate the cylinders. The rotating disk is mounted on large ball bearings for ease of indexing. At present, only a 9-inch diameter model is carried in stock, but larger sizes are made to order.

Plastic piping is now available for handling liquids that corrode metal and is gradually making a place for itself in various industries. Du Pont's Alathon polythene-resin tubing, for instance, is considered to be suitable for mine service. One man, it is said, can lay 1000 feet of 2-inch size in less than an hour.

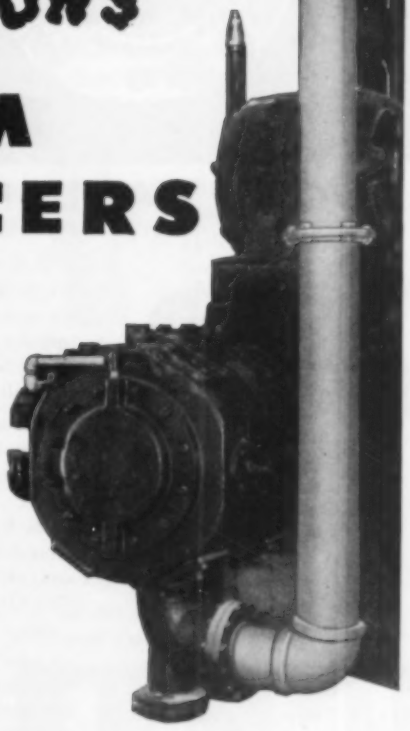
In view of the increasingly important part played by radiography in industry, the Ansco Division of General Aniline & Film Corporation is offering for the first time a complete line of X-ray films to meet the diversified needs of the industrial and scientific radiographer. They can be used with low or high kilovolt X-ray exposures, or with radium or cobalt gamma radiation, and can be relied upon to give radiographs of high diagnostic quality. Details about the line are contained in a 4-page folder which can be obtained from the X-Ray Department, Ansco, Binghamton, N. Y.

"There's the one that's been breaking up our home."

STOP

INTAKE NOISE AND PULSATIONS WITH

MAXIM SILENCERS



Maxim Silencers are made for compressor intake and discharge, vacuum pump discharge, blower intake or discharge, internal combustion engine exhaust or intake, high velocity steam, air or gas discharges, spark arresting and for engine exhaust silencing with heat recovery features.

Consult MAXIM

THE MAXIM SILENCER COMPANY

61 Homestead Ave., Hartford 1, Connecticut, Dept. W. L.

Gentlemen: Please send me your bulletin on silencers for
☐ Compressor Intake ☐ Internal Combustion Engines
☐ Steam Blow-off ☐ Spark Arresting ☐ Heat Recovery.

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THE VICTAULIC METHOD OF PIPING

EASIEST WAY TO MAKE ENDS MEET

"Vic-Groover" Tools save time, save money, are an important feature of the famous Victaulic Method. These portable, easy-to-operate pipe groovers prepare pipe ends easily and quickly right on the job to receive Victaulic Couplings and Fittings!

The *complete* Victaulic Method comprises: easy-to-install Victaulic Couplings for assured leak-proof connections and a union at every joint . . . a complete line of Full-Flow Elbows, Tees, Reducers, and other modern Fittings that offer wide adaptability and versatility . . . and, of course, unique, fast-working "Vic-Groover" Tools.

Why not give the Victaulic Method a tryout on *your* next piping job? You'll find that mis-alignments, expansion and contraction are automatically taken care of with Victaulic and you'll have assured lock-joint, leak-proof piping!

For new construction . . . repairs . . . alterations, use the VICTAULIC METHOD . . . *it's the easiest way to make ends meet!*

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Canada: Victaulic Co. of Canada Ltd., 406 Hopewell Ave., Toronto 10
Export: Pipe Couplings, Inc., 30 Rockefeller Plaza, N. Y. 20, N. Y.

Books and Industrial Literature

In a new book by Joseph Marin, titled *Engineering Materials*, it is pointed out that design men and machinery manufacturers cannot afford to relax in their efforts to keep abreast of the mechanical properties of engineering materials because of the introduction of new machines and materials, the use of higher speeds and temperatures, the changes in operating conditions and the decrease in factors of safety. The 482-page work is written in three parts: section one covers the mechanical properties of materials and their utilization; part two is a brief treatment of a number of important engineering materials; and part three discusses the more important testing machines and strain gauges used in determining the mechanical properties of materials. The object of the book is to provide students with sufficient knowledge of the behavior of stressed materials so they can select and use them intelligently. Published by Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $8.70.

The Engineer, noted London technical weekly, has published its 1952 *Directory and Buyers Guide*. This 440-page book lists more than 1250 leading British manufacturing concerns and is a handy reference work for industry and especially for buyers of engineering products and services. Cost per copy to nonsubscribers of the weekly is 5s ($0.70) postpaid. Address order to The Manager, The Engineer, 28 Essex Street, Strand, London, W. C. 2, England.

Vacuum engineers may be interested in two new data sheets obtainable from Distillation Products Industries, Rochester 3, N. Y. The literature contains information on Type MCF diffusion pumps and vacuum pump fluids, respectively.

The Pyle-National Company, 1334 N. Kostner Avenue, Chicago 51, Ill., is distributing free a series of six bulletins, five dealing with the different types of steam, gas, and air turbines it manufactures and one giving general turbine information.

In a 4-page folder, Octagon Process, Inc., 15 Bank Street, Staten Island 1, N. Y., describes its Rustshield 2 as a chemical treatment that gives moving metal parts an oil-retaining rustproof surface. Copies of the illustrated publication are available upon written request.

Haynes Stellite Company has published a 24-page booklet describing its wide variety of industrial cast- and wrought-alloy parts being used widely to solve abrasion, corrosion and high-temperature problems. Copies of *Long-Wearing Machinery Parts* are available from the firm at 30 East 42nd Street, New York 17, N. Y.

Eight methods of blasting with millisecond delays are described in a well-illustrated 20-page manual recently published by Altas Powder Company, Wilmington, Del. Copies are available to those interested in quarrying, coal stripping, open-pit shooting or the production of aggregates on construction projects.

Thirty-nine specific industrial applications of automatic or semiautomatic air-operated devices are described and illustrated in a booklet, *Air Power at Work*, published by Mead Specialties Company, 4114 North Knox Avenue, Chicago 41, Ill. They represent the solutions of production

problems that confronted manufacturing plants of different kinds. Included are various combinations of work feeders, air presses, timers, valves, etc.

Those interested in the principles of rectification and the characteristics of selenium rectifiers can avail themselves of a 28-page booklet on the subject announced by the Lighting and Rectifier Department, General Electric Company, Schenectady 5, N. Y. It is designated as GET-2350.

The Michigan Tool Company, 7171 E. McNichols Road, Detroit 12, Mich., has published a 4-page bulletin, designated as H-52, which discusses its precision-ground and unground hobs for the production of gears, splines, etc. It also contains a table of tolerances of the various types as a guide to intelligent selection.

The Toledo Pipe Threading Machine Company, one of the nation's pioneer manufacturers of pipe-threading tools and power pipe machines, is celebrating its fiftieth anniversary and has published a handsome brochure which tells the story of its origin and development. It is available to all its customers through distributors and jobbers.

Interested in lubricants? Do you know why molybdenum disulphide is an aid in the assembly and disassembly of closely fitting parts and why it is being used as a lubricant where others fail? A booklet entitled *Moly-Sulfide*, published by Climax Molybdenum Company, 500 Fifth Avenue, New York 18, N. Y., gives the answers and shows many varied applications.

Allis-Chalmers Manufacturing Company, S. 70th St., Milwaukee, Wis., has released a bulletin—51B7149B—on its line of totally enclosed, fan-cooled motors with tube-type air-to-air heat exchangers in ratings from 40 hp at 600 rpm through 800 hp at 3600 rpm and in standard and explosionproof designs. Copies will be mailed upon request.

There is now available on request from J. E. Rhoads & Sons, 35 N. 6th Street, Philadelphia 6, Pa., a complete file of data sheets covering each of its varied line of Tannate industrial leathers, including packings suitable for hydraulic and pneumatic equipment. Service, maintenance and storage hints are offered, together with drawings.

A down-to-earth explanation with drawings of representative types of fluid power circuits is the aim of a 28-page, pocket-size manual prepared by Logansport Machine Company, Inc., Logansport, Ind. Called the *Circuit Rider*, it attempts to bring out the many possibilities afforded by the use of different types of circuits. The booklet will be mailed upon request.

Aluminum powders go into a great variety of goods and serve industry and science in many ways. Showing their applications, tracing their development and describing three modern methods of production, is an 84-page manual titled *Aluminum Powders and Pastes* published by Reynolds Metals Company, 2500 S. 3rd Street, Louisville, Ky. Copies are available by writing the company on a business letterhead.

As an aid in the selection and sizing of variable-area flow meters, Fischer & Porter Company, Hatboro, Pa., has published a 40-page illustrated handbook which gives, in condensed form, the results of fifteen years of research by its engineering department. It contains a complete description of variable meters, tubes and floats, a comparison of the operating characteristics of variable-area meters with variable-head meters, calibration prediction data, and other information. A copy is obtainable from the company upon request.

A 36-page bulletin published by The Bristol Company, Waterbury 20, Conn., describes its line of Dynamaster electronic potentiometers and bridge instruments for process, laboratory and industrial- and pilot-plant use and also gives information on new electronic instruments for recording and indicating such variables as temperature, pH, speed, voltage, power, current, smoke density, thickness, strain, and others that can be measured in terms of d-c current, d-c voltage, resistance, or capacitance. Designate Bulletin No. P1245 when asking for a copy.

"Sure he's going deep, but where's he putting the dirt?"

LE-HI Makes a Good Connection TOO!

Specify LE-HI for all Hose Couplings!

Wherever hose is used there is a LE-HI hose coupling to match—from small tubing to large industrial applications.... The complete LE-HI line includes:

- Air Tool Couplings
- Welding Hose Couplings
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SERIES 100

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- Drilling Hose Couplings
- Oil and Gas Hose Couplings
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. . . plus complete lines of hose clamps, air valves and manifolds.

Sold through leading distributors and rubber manufacturers only.

"Old Doc" says: "Write now for your free copy of the complete LE-HI catalog"

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1722 Lehigh Ave.
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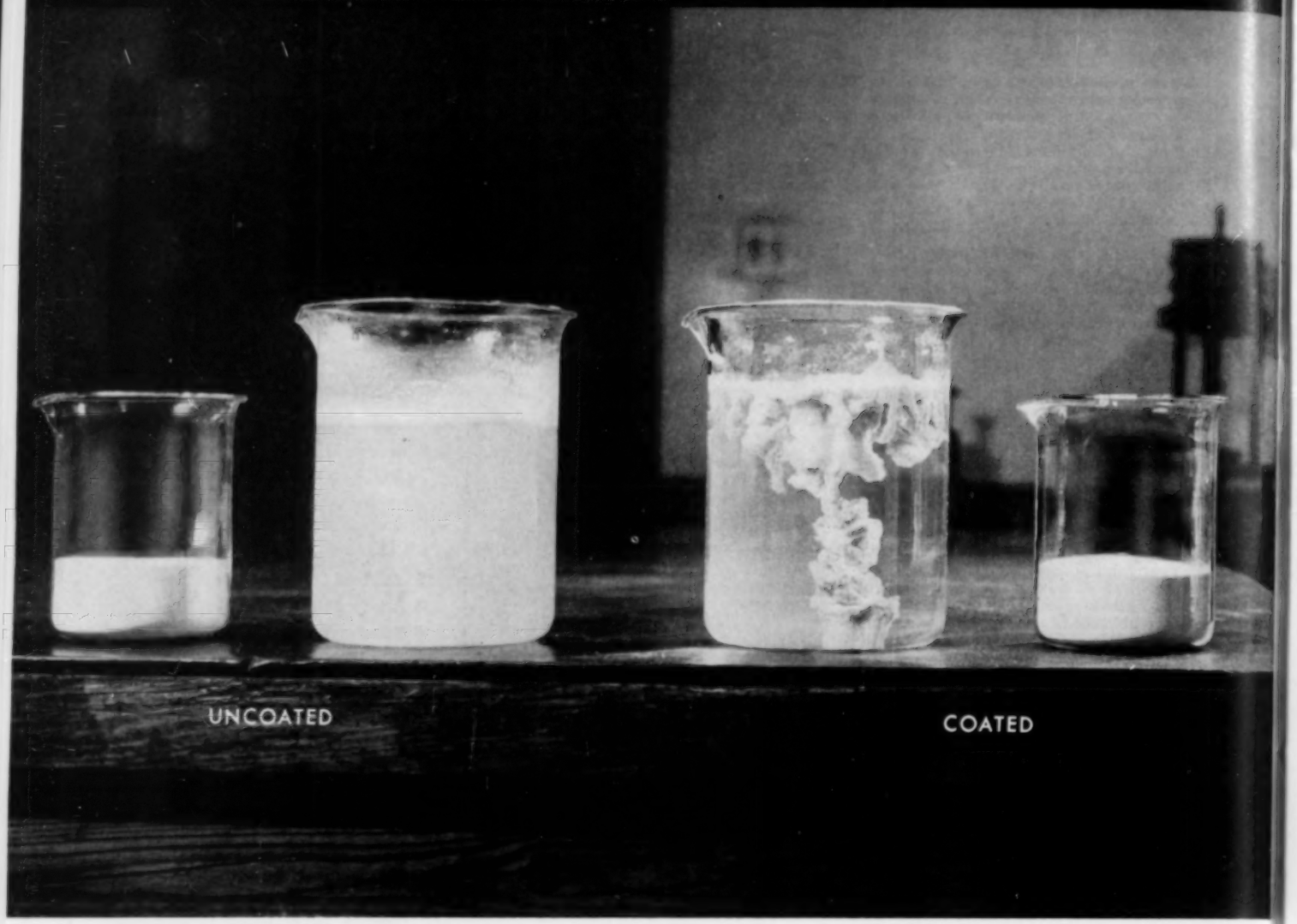
HIGH and LOW PRESSURE
HOSE COUPLINGS
TRADEMARK REGISTERED

PROGRESS IN EXPLOSIVES . . .



WHICH BEAKER HAD THE BANG?

The small beaker (left) contains ammonium nitrate. This is an important explosives ingredient, but it absorbs moisture readily. Notice in the large beaker (left)—how it dissolves immediately in water.

The small beaker (right) contains *Hercules* ammonium nitrate *treated with a special resin*. In the large beaker (right) note how the resin-treated ammonium nitrate repels water without affecting explosives' properties.

Here is a simple example of Hercules' pioneering that gives you better blasting efficiency under adverse storage and climatic conditions both in manufacture and in field use.

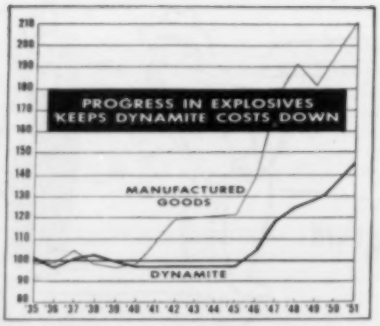


Chart shows relative stability of dynamite prices since 1935, as compared with prices of other manufactured goods. 1935-39 values=100.

HERCULES POWDER COMPANY

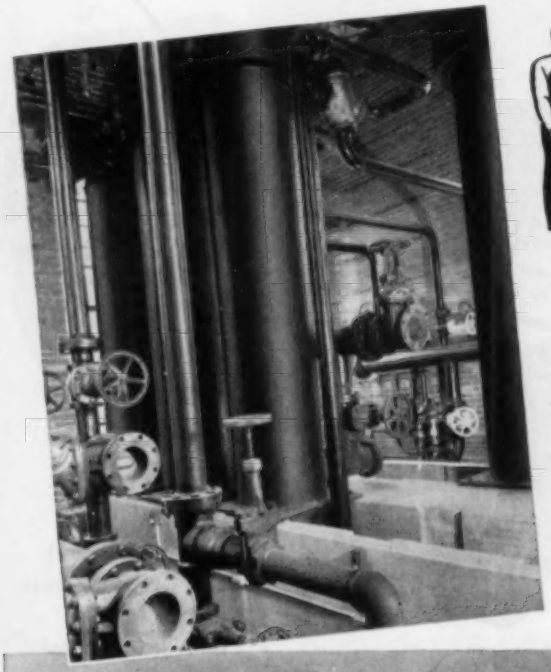
INCORPORATED

Explosives Department, 932 King St., Wilmington 99, Del.

XR52-4

Dirty Water can't "Shut-down"...

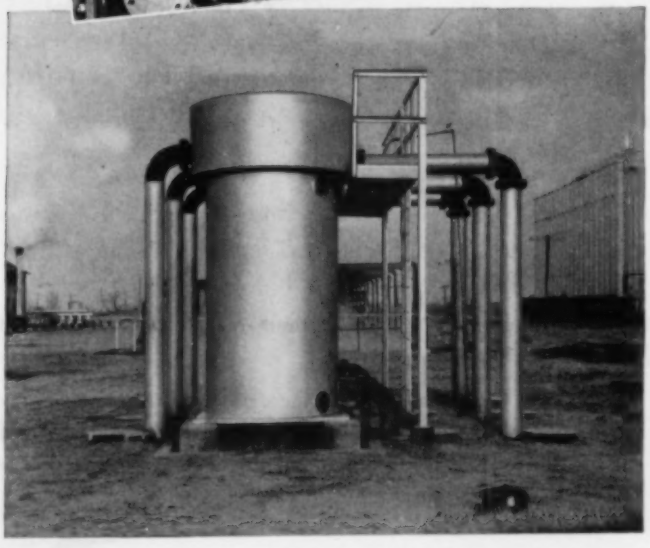
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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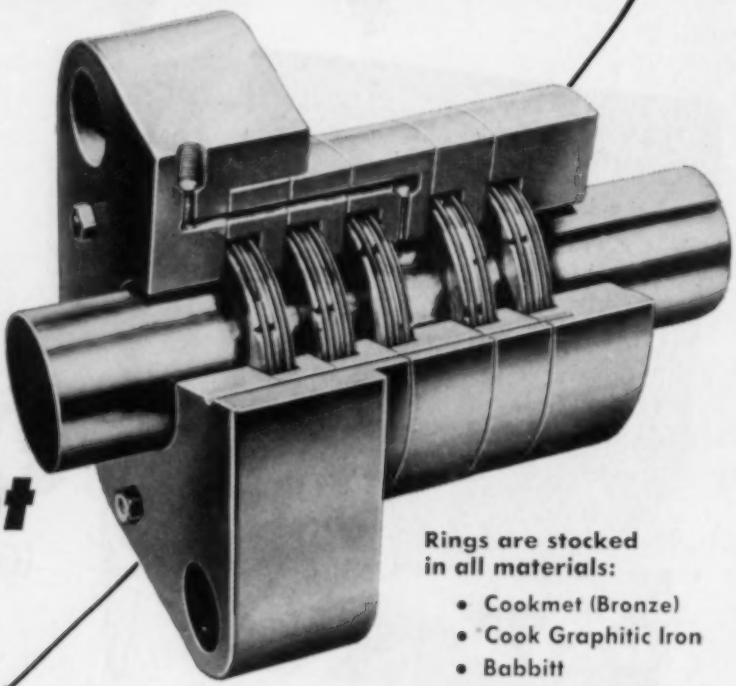
. . . for fast service on packing replacement parts!



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- Cookmet (Bronze)
- Cook Graphitic Iron
- Babbitt
- Cookroc (Bakelite)

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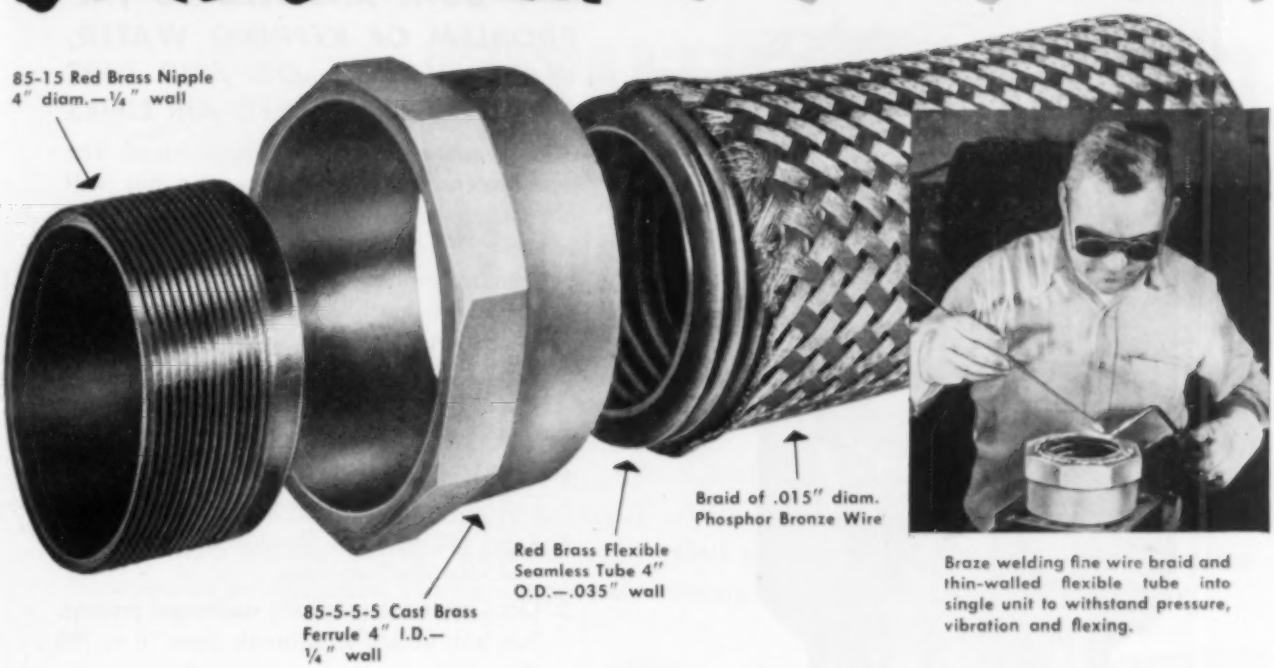
ROD PACKINGS

. . . SEALING PRESSURES SINCE 1888 . . .

How to produce it profitably?

braze weld it—of course!



Braze welding fine wire braid and thin-walled flexible tube into single unit to withstand pressure, vibration and flexing.

This assembly must hold liquids, steam or gas under high pressures—while withstanding vibration and continuous flexing. Made up of dissimilar metals of widely varying thickness, it's braze welded on a production basis with ANACONDA 997 Low Fuming Bronze Rod.

ANACONDA Bronze Welding Rods can keep your welding costs down with fast, strong, uniform welds on even the most difficult production jobs. Our Technical Department will gladly help you with any bronze welding problem. ANACONDA Welding Rods are sold by distributors throughout the United States. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

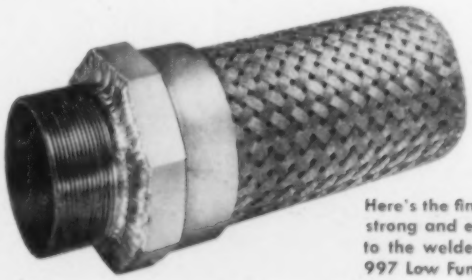
51149

Now the red brass nipple and cast brass ferrule are joined together and to the first weld. This calls for pressure-tight joint between nipple and flexible tube and a strong joint to the ferrule.

For every braze weld, there's an

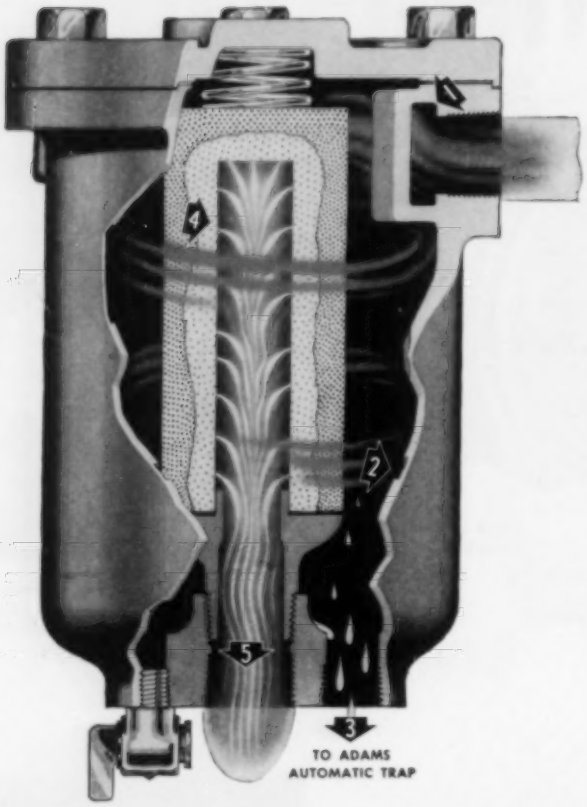
ANACONDA®

BRONZE WELDING ROD



Here's the finished job, neat, tight, strong and economical — a credit to the welder and to ANACONDA 997 Low Fuming Bronze Rod.

ADAMS *has both* *



—— BOTH ANSWERS TO THE PROBLEM OF KEEPING WATER, WATER VAPOR, OIL AND DIRT OUT OF COMPRESSED AIR LINES

There's no *one* answer to this problem! The most expensive aftercooler you can buy will not remove scale that is picked up in the distribution lines. The most expensive air filter you can buy cannot guarantee removal of water vapor until it has been condensed by cooling. That's why Adams makes both.

* PORO-STONE *AIR FILTER*

1. Centrifugal separation of dirt and liquids.
2. Drainage to trap directed by vertical cast-in slots.
3. Continuous, fully automatic trap action.
4. Rapid diffusion and filtration through permanent, cleanable Poro-Stone.
5. Clean, dry air at practically unchanged pressure. Standard, stocked sizes handle from 10 to 700 cfm.

Easily installed in either vertical or horizontal pipe line.

* AFTERCOOLER AND CYCLONE SEPARATOR

Cools air to within a few degrees of cooling water, making certain that compressed air is colder than surrounding atmosphere, so that no further condensation can take place.

Counter flow, air-through-tube design assures continuously high heat transfer rate.

Double cyclonic action deposits all water and entrained oil in moisture chamber.

R. P. ADAMS CO., INC.
209 E. Park Drive, Buffalo 17, New York

Please send me your latest literature, Bulletin No. 176 on BOTH the Poro-Stone air filter and the Adams Aftercooler — Cyclone Separator.

Name .....

Company ..... *Title* .....

Address .....

City ..... *State* .....

FOR YOUR PROFIT'S SAKE —FIND OUT ABOUT BOTH

R. P. ADAMS CO., INC., BUFFALO 17, N. Y.

When the going is tough

LOUIS ALLIS

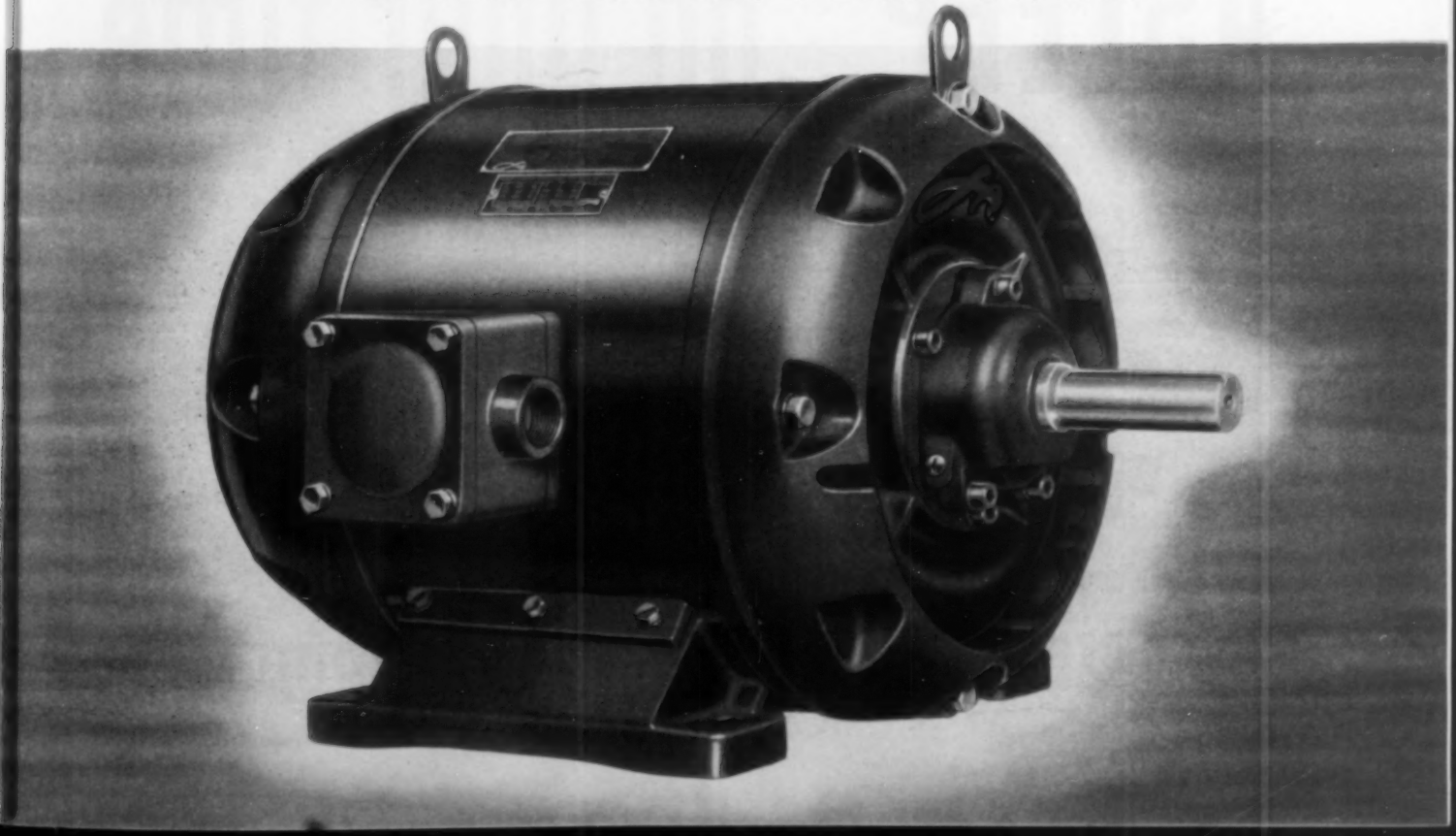
TOTALLY-ENCLOSED FAN COOLED MOTORS

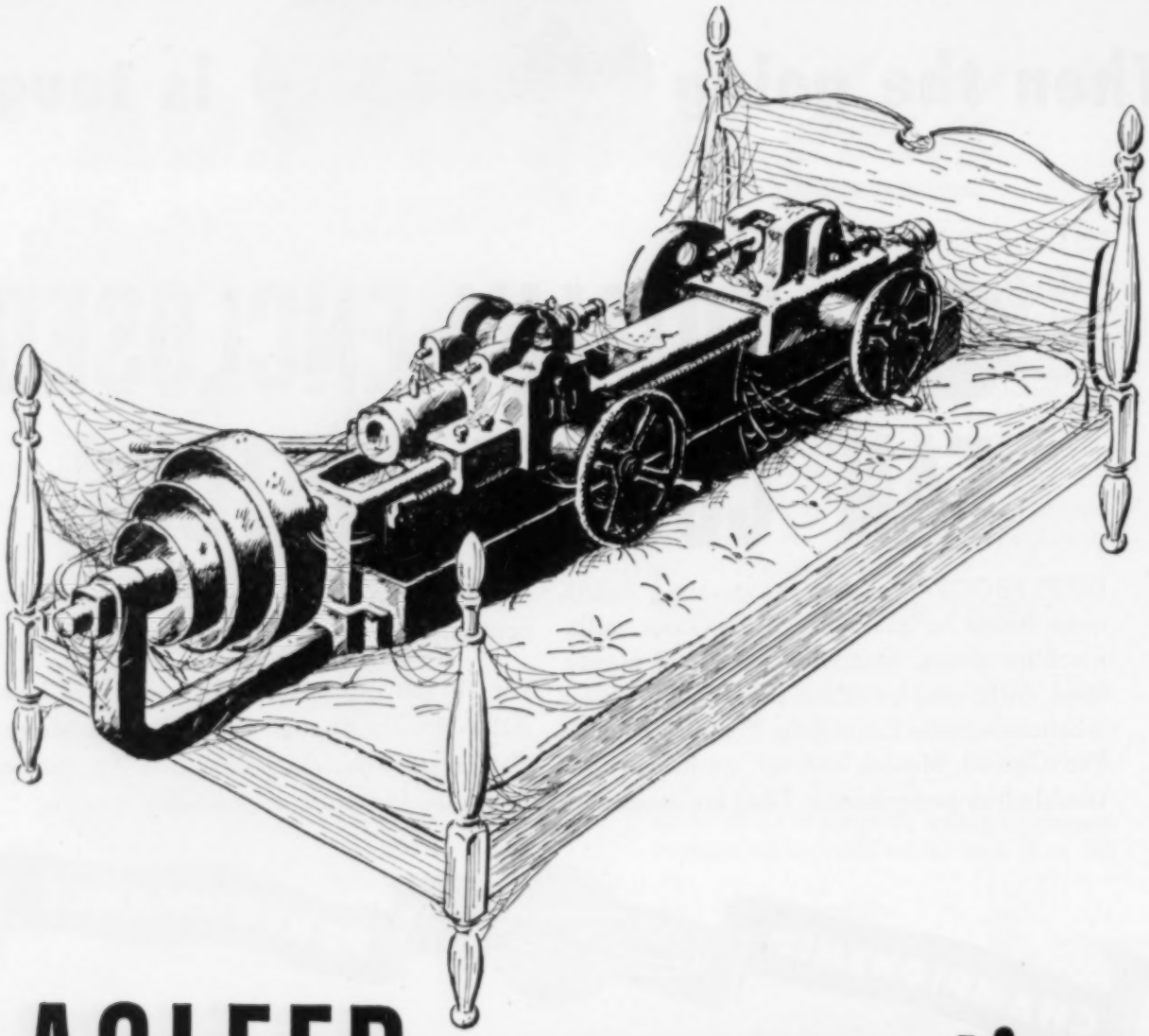
DUST-PROOF—For severe operating conditions found in grain elevators, flour mills, machine shops, foundries, chemical plants, steel mills, coal handling plants, and similar locations—these Louis Allis Totally-Enclosed Fan-Cooled Motors deliver uninterrupted trouble-free performance. They are especially designed and built for use in atmospheres containing combustible or abrasive dust.

For all the dusty, dirty jobs—specify Louis Allis Totally-Enclosed Fan-Cooled Motors. Call in your nearest Louis Allis Application Engineer for quick dependable service.

CHAMPIONSHIP PERFORMANCE

THE LOUIS ALLIS CO., Milwaukee 7, Wis.





ASLEEP...on your time

An obsolete or worn-out machine, stuck away, sleeping and forgotten in a corner of your plant, is costly.

It is not doing you or anyone else any good. It is taking up valuable space.

Call in a scrap dealer and let him haul away your dormant scrap. It will help to supply the tons of additional scrap that is needed if the country's steel furnaces are going to continue working at full capacity.

Today there are millions of tons of dormant scrap hidden away in plants and factories, and on farms.

If the steel mills can get that scrap, the steel supply picture will be very much brighter, with more steel for everybody. Call in a scrap dealer today!

BETHLEHEM STEEL

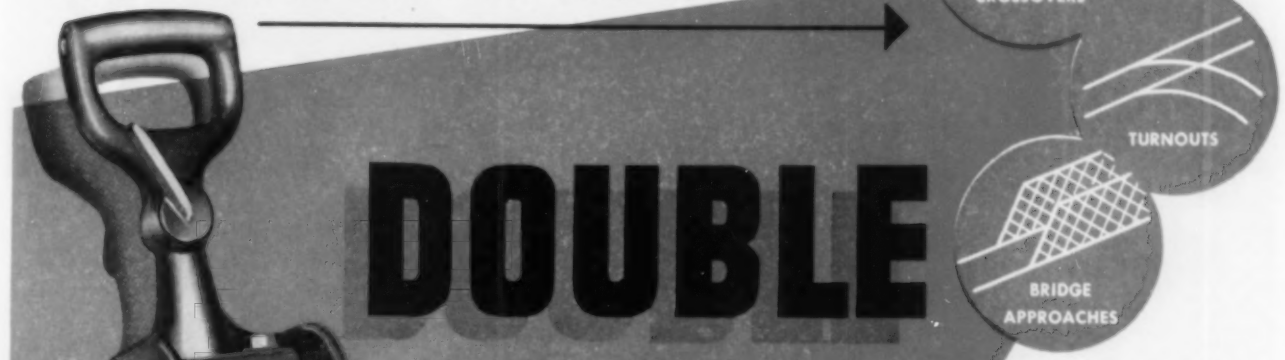
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

More Scrap Today...More Steel Tomorrow

Ingersoll-Rand Heavy Duty

AIR TAMPING GUN

Speeds up jobs where tie tamping is toughest



DOUBLE POWER

for tighter tamping!

It's *New!*

Compact . . .

Extra-powerful . . .

Convenient throttle is protected . . .

Air inlet quickly changed to left-hand operation . . .

Handles easily!

THE NEW MT8 gives you twice the power of standard tamping guns! It's designed to insure better work at fixed elevations! It is also an excellent tool for spot tamping under difficult ballast conditions!

The trend today is toward heavier rails and longer ties to meet increased traffic. Tighter tamping that stands up longer is a "must" these days.

That's why the powerful I-R MT8 Tamping Gun does a better job for you. Although it develops twice the power of the standard tamping guns, it only weighs 14½ pounds more, and is well-balanced for easy handling. Standard tamping steels are used.

Give the new MT8 a try-out and notice its low air consumption. You can operate two of these extra powerful guns from one portable 3R36 Spot Air Compressor!

Get full details on the MT8 from your nearest I-R branch office. You'll get prompt attention if you call, write or wire.

Ingersoll-Rand ORIGINATOR OF MECHANICAL TAMPING

11 Broadway, New York 4, N. Y. 732-11

Look To The First — For The Finest

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Resists Every Service Hazard LONGER

"SUBWAY" Air Hose

The real proving ground for "SUBWAY" is on your toughest rock drilling jobs, where hose is constantly subjected to pulling, twisting and dragging over rough, abrasive surfaces. You wonder how *any* hose can survive the punishment so *long!*

The red rubber cover hits a new high in wear- and weather-resistance. The high quality wrapped duck carcass has extra strength and stamina. The oilproof tube is a long-lasting black rubber compound. Minimum weight and extreme flexibility assure easy handling.

"SUBWAY" will, of course, serve with equal efficiency and economy in pavement breaking and any other heavy duty air tool work. Available in sizes ½" to 1¼", I. D., in maximum lengths of 50 feet.

Contact Our Nearest Branch for Details

GOODALL RUBBER COMPANY

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches: Philadelphia · New York · Boston · Pittsburgh · Chicago · Detroit · St. Paul · Los Angeles
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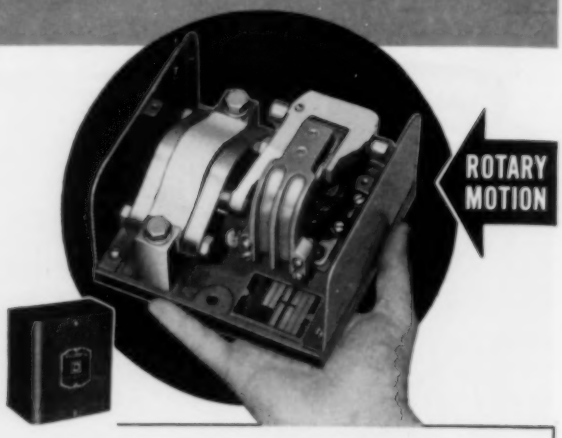
Est. 1870

NEW..Magnet-Operated Valve



● Fast Operation · Low Pressure Drop · Long Life · Low Power Consumption · Compact · Accessible · Easily Installed.

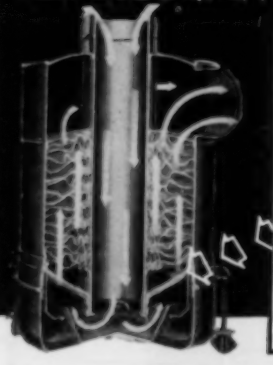
Write for Bulletin 9043 Type C, Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin

Ask Your Electrical Distributor for Square D Products

SQUARE D COMPANY

DETROIT · MILWAUKEE · LOS ANGELES

"New Tray-Type" AIR CLEANER removes and holds more dirt!



RECOMMENDED FOR HIGH-CAPACITY ENGINES on large tractors, rock crushers, power shovels, etc. Large dirt-holding capacity allows longer interval between servicing.

REMOVABLE TRAY SIMPLIFIES SERVICING. Entire tray is quickly removed for cleaning. Multiple screens prevent clogging of condensing element.

IN THIS NEW Donaldson heavy-duty cleaner, the removable multi-screen "tray" and revised oil cup design feeds more of the condensed oil back into the air stream adjacent to the center tube.

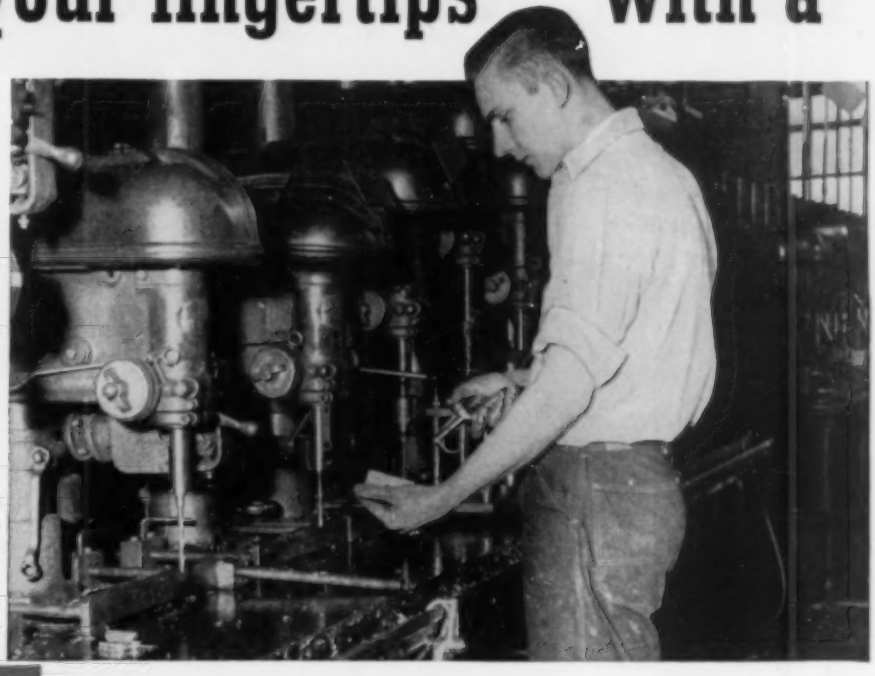
A balanced distribution of oil across the entire lower element has been achieved, eliminating both overloaded and "thin" areas.

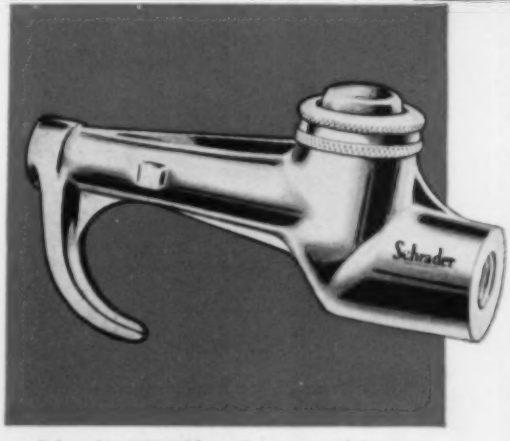
Extensive tests in the field over a period of five years prove conclusively that the new cleaner has a higher efficiency and a greater dirt-holding capacity. We invite manufacturers to write or call for design data and test reports.

DONALDSON CO., INC. 666 Pelham Blvd., St. Paul 4, Minnesota
Donaldson Co. Ltd. (Can.), Chatham, Ont.

Donaldson AIR CLEANERS

Put air at your fingertips with a Schrader Blow Gun





Schrader 9326 Blow Gun—one of thirty-six designs and styles for you to choose from.

You'll find there are Schrader Blow Guns that *just suit* any operation you may have . . . blow guns that put air *where* you want it . . . when you want it . . . reliably and economically. The #9326 Schrader Blow Gun shown here, for instance, will take years of the toughest treatment you can give it. Here's why . . .

- **It's rugged,** both in design and construction. This Schrader Blow Gun is drop forged of stainless steel to give you years of trouble-free service. Combine this with its countersunk nose and shielded operating button—and you'll see why it went right back on the job, even after we dropped it out of a tenth-floor window . . . then ran over it with a six-ton truck.
- **It's convenient**—Notice the handy hang-up hook. Hang the gun close to where you need it . . . and remember, too, this hook acts as a safety guard, to help keep hands away from moving machine parts.
- **It's economical**—This Schrader Blow Gun—or *any* Schrader Blow Gun—shuts off tightly the instant you lift your finger. A Schrader Blow Gun delivers air only while it's needed.
- **Thirty-six** designs and styles of Schrader Blow Guns—drop forged stainless steel or brass . . . button type . . . lever type . . . adjustable nose . . . flexible nozzle . . . angle nozzle are available. To find *exactly* the blow gun you need, check with Schrader.

You'll get facts by return mail. Just write—or fill out the coupon below.

Schrader
REG. U. S. PAT. OFF.

products control the air

Air Cylinders • Operating Valves • Press & Shear Controls • Air Ejection Sets • Blow Guns • Air Line Couplers • Air Hose & Fittings • Hose Reels • Pressure Regulators & Oilers • Air Strainers • Hydraulic Gauges • Uniflare Tube Fittings

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Division of Scovill Manufacturing Company, Incorporated
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I am interested in more information on.....

Name_____ Title_____

Company_____

Address_____

What are you doing about the *third control?*

3 ENTRAINMENT CONTROL

2 TEMPERATURE CONTROL

1 PRESSURE CONTROL

TYPE ID PURIFIER INSTALLED IN EVAPORATOR

ON

- STEAM DRUMS
- FLASH TANKS
- EVAPORATORS
- PACKED TOWERS
- DEODORIZERS
- STILLS
- BUBBLE-CAP TOWERS
- RECEIVERS

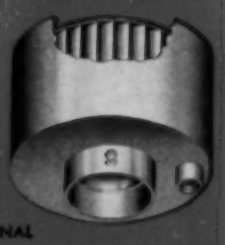
• Frequently you give serious thought and attention to *pressure* and *temperature control.* This is quite natural because it means better operation and more production and often prevents damage. But what about the *third control—entrainment control.* Lack of this control can be just as costly as lack of pressure and temperature control.

Lack of the third control can mean shut downs and loss of production due to entrainment wear in engines and process equipment. Larger slugs of entrainment have been known to blow off cylinder heads of reciprocating engines and to ruin thrust bearings of turbines.

Lack of third control means poor efficiency of superheaters, steam ejectors, dryers and other equipment. It means dirty pipe lines and fouled valves.

End this damage *once and for all* with Hi-eF Purifiers. They remove 99% of all entrainment. Individually guaranteed, Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than an ordinary separator. Write us today about your entrainment problem. Let our engineering staff, without the slightest obligation, give you the proper solution.

ANDERSON Hi-eF PURIFIERS



DOWNFLOW INTERNAL PURIFIER

PURIFIER DIVISION,

THE V. D. ANDERSON COMPANY

1996 West 96th Street • Cleveland 2, Ohio

Gentlemen: Please send additional information on Anderson Hi-eF Purifiers.

Name_____

Company_____

Address_____

City_____ **Zone**___ **State**_____

How TIMKEN® bearings are instrumental in supplying instrument air

THIS Ingersoll-Rand air compressor is in use at the Tanners Creek Generating Station of the Indiana & Michigan Electric Company. Its job: to supply air for instruments at the station.

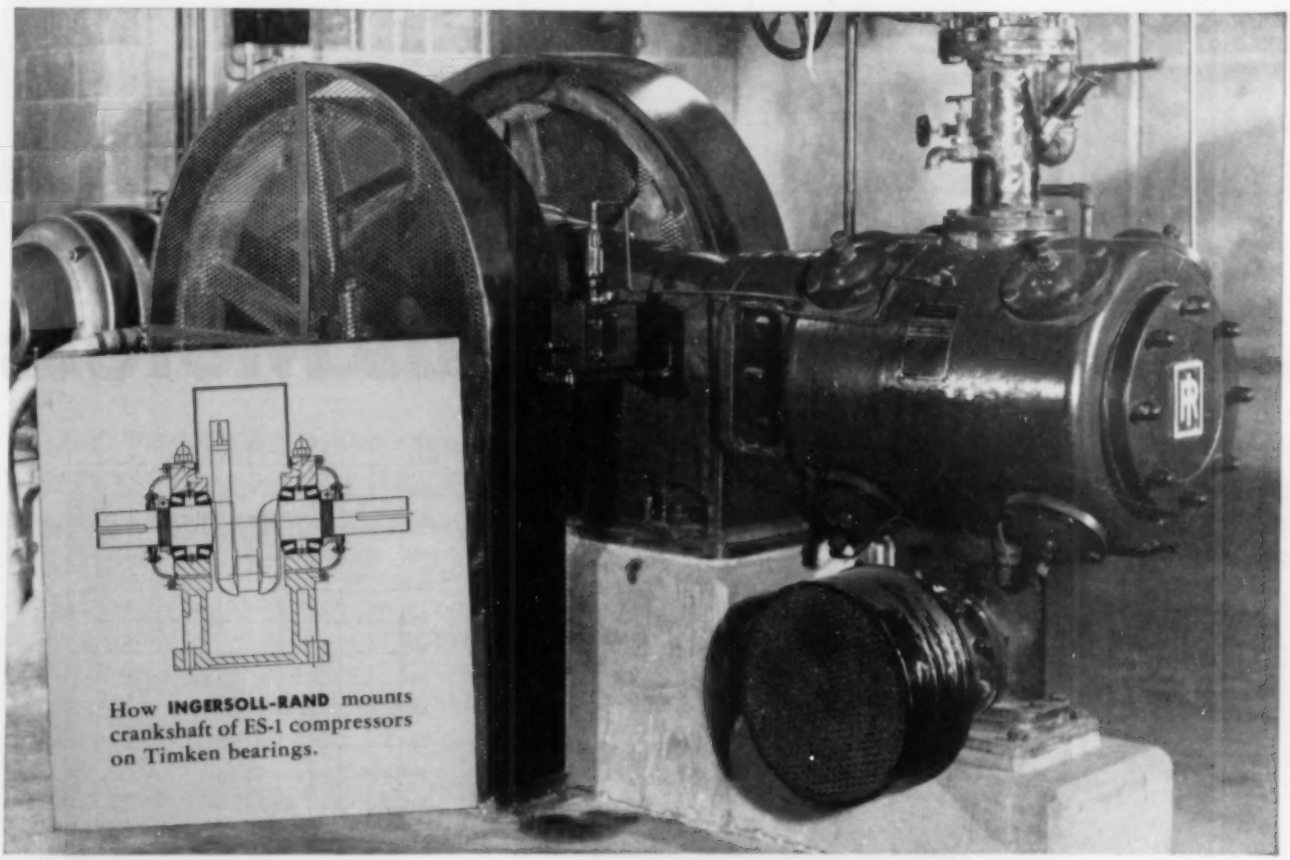
Like many other Ingersoll-Rand compressors, it is equipped with Timken® tapered roller bearings on the crankshaft. As a result, it does its job for the Tanners Creek Station dependably and at less cost for maintenance.

Because of their tapered construction, Timken bearings take radial and thrust loads in any combination, hold the compressor's crankshaft in positive alignment. This reduces wear on related parts. Since Timken bearings keep housing and shafts concentric, they make closures more effective. Dirt is kept out, lubricant kept in. Maintenance time is cut to a minimum.

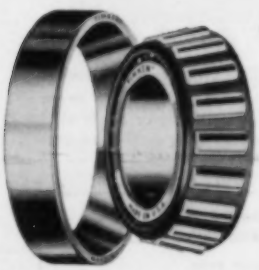
Timken bearings normally last the life of the compressor: they're engineered for the job, precision manufactured, and made of Timken fine alloy steel.

Timken bearings give you more advantages than any other bearing. Be certain they are in the equipment you buy and the equipment you build. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **INGERSOLL-RAND** mounts crankshaft of ES-1 compressors on Timken bearings.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

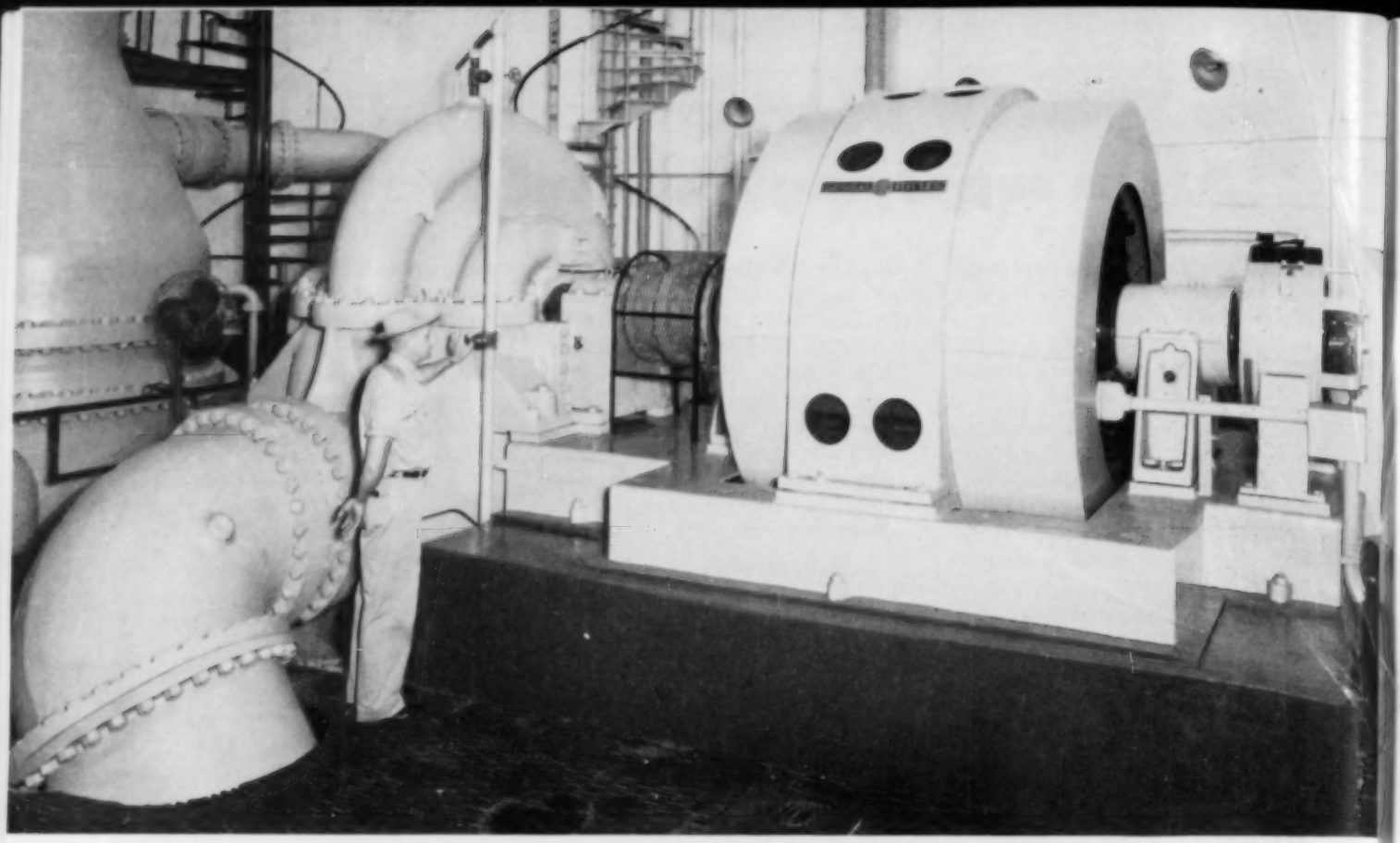
TAPERED ROLLER BEARINGS

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

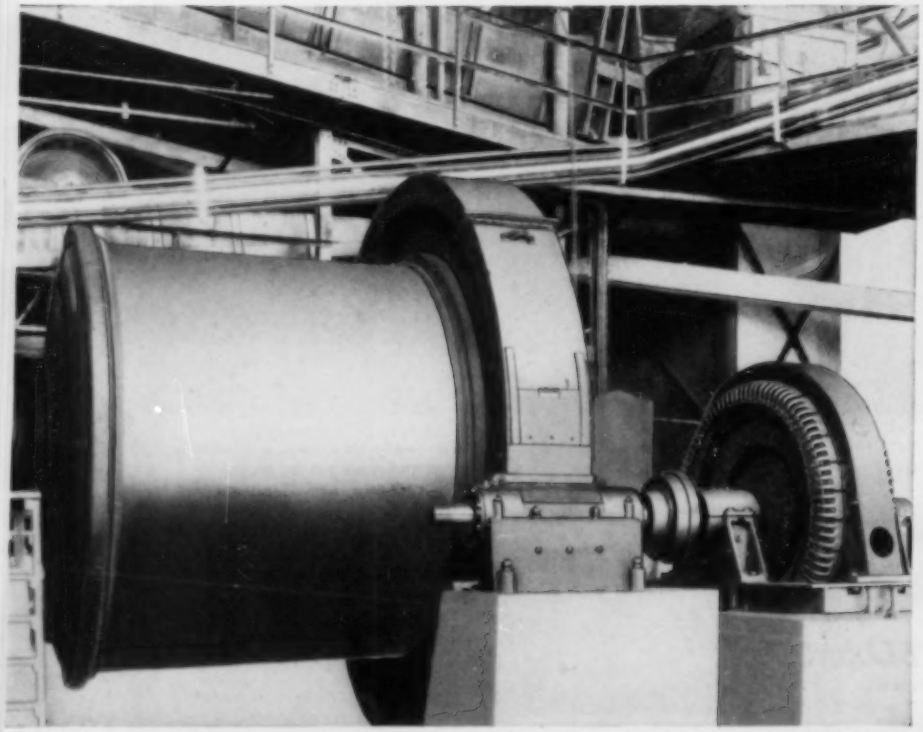
The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

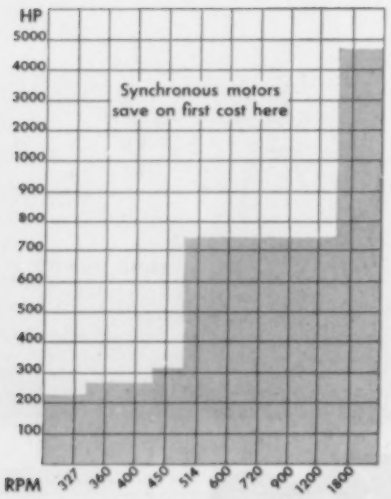


Savings in distribution equipment investment were made possible by selection of this General Electric 2500 hp synchronous motor for a municipal pumping station.

G-E Synchronous Motors

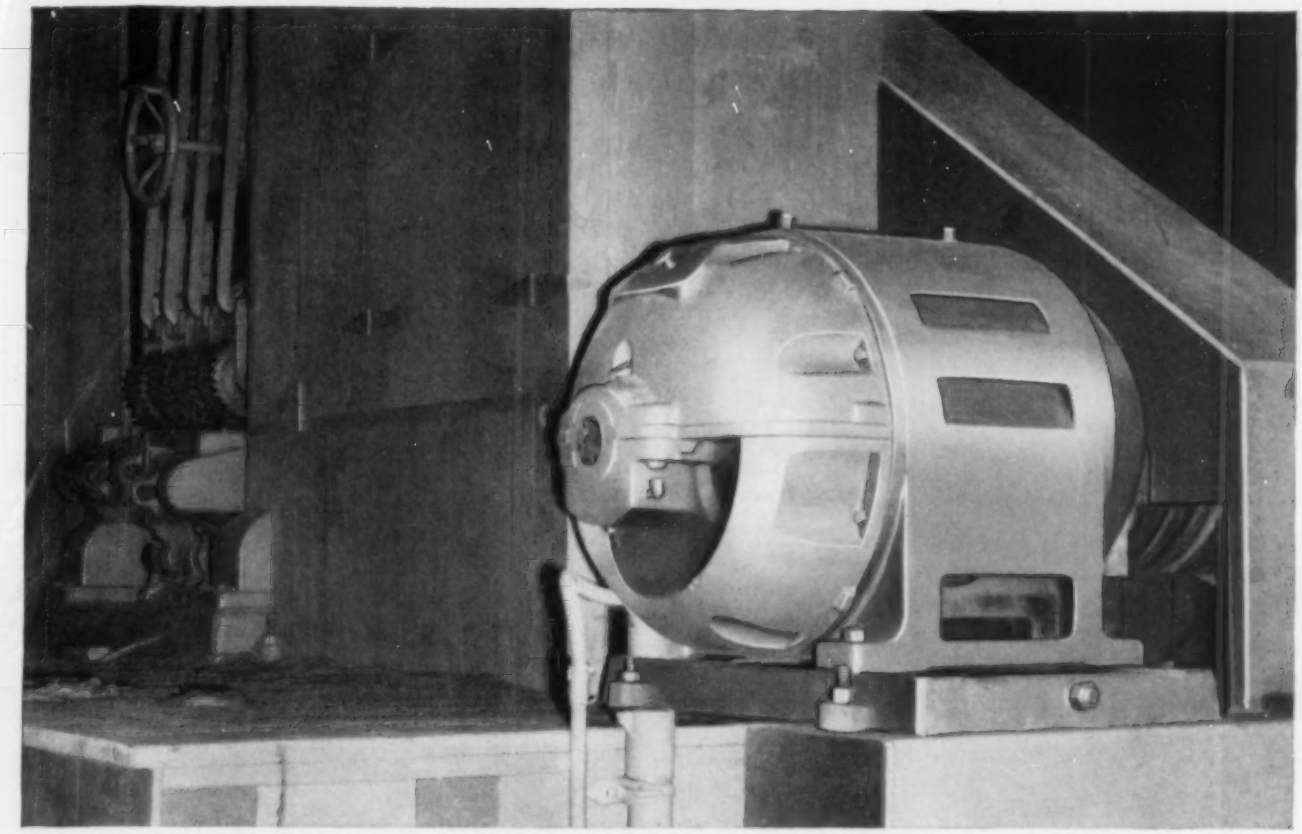


To meet the tough starting requirements of a ball mill, a mining company chose this G-E high-torque synchronous motor rated at 600 hp. Initial cost was low and the motor has given 20 years of dependable service.



Lower first cost of G-E synchronous motors is shown above. For applications in the white area, synchronous motors cost less than any other kind of motor. Calculations below show power savings on a typical 1000 hp, 514 rpm motor.

Gain in efficiency over other types of motors at same rating	2.2%
Hourly saving at power rate of $0.01 per/kwh	$0.184
Yearly saving (assuming constant operation)	$1600.00



Lower operating cost is the rule when General Electric Tri-Clad* synchronous motors are used with equipment such as this horizontal band re-saw, operating almost continuously at heavy loads.

Offer Double Savings

Lower First Costs, Lower Operating Costs Can Be Realized on Large, Constant-Speed Applications in Many Industries

Before you select a drive for a large equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. On many applications such as pumps, compressors, fans, etc., outstanding savings are available.

LOWER FIRST COSTS

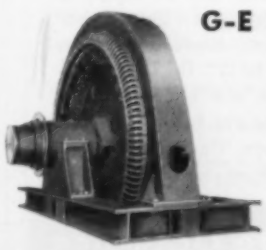
In most ratings where horsepower is equal to or greater than speed, the price tag on a synchronous motor with exciter and control is less than that of any other a-c motor with its control.

And, because a synchronous motor improves plant power factor, initial investment in distribution equipment frequently can be reduced. (The load which any new or expanded power system will carry is proportional to the plant's power factor.)

LOWER OPERATING COSTS

A synchronous motor usually has a higher full-load efficiency than any other type of motor, produces more work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0% in efficiency pays off.

Engineers with many years of field experience will tailor G-E synchronous motors and control to your job. Call in your General Electric representative—he'll be glad to discuss your particular application. And for more information on G-E synchronous motors, write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) to Section 770-26, *General Electric Company, Schenectady 5, N. Y.*



BE SURE TO SPECIFY G-E SYNCHRONOUS MOTORS

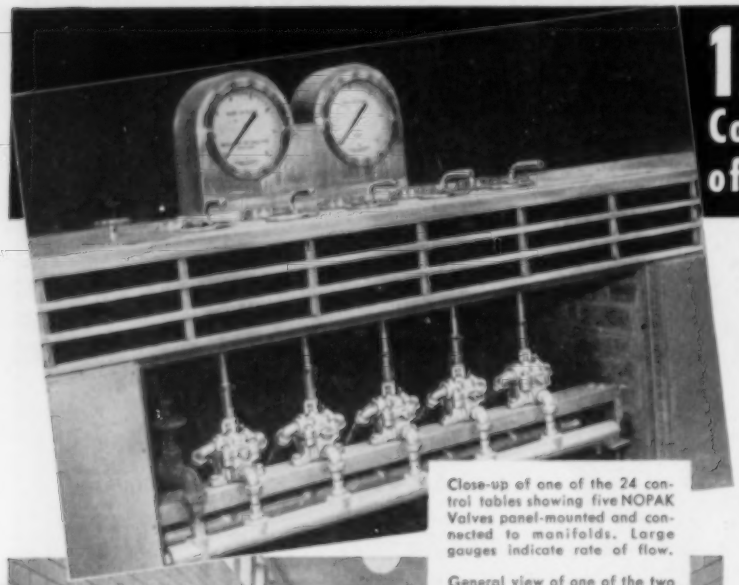
The result of more than 55 years experience in development, manufacture, and successful application, General Electric's line of synchronous motors is available in low speed and high speed types, engine-type and Tri-Clad* construction.

Numerous exclusive design and construction features promote long, dependable service. Get the full details!

**Reg. trademark U.S. Pat. Off.*

GENERAL ELECTRIC

770-26



Close-up of one of the 24 control tables showing five NOPAK Valves panel-mounted and connected to manifolds. Large gauges indicate rate of flow.

General view of one of the two filter galleries. Each has 12 control stations.

120 NOPAK Valves Control *Intake and Drain Gates* of Nottingham Filtration Plant

This recent major addition to Cleveland's water supply system, having a normal capacity of 100,000,000 gallons per day, employs water-hydraulic valves and cylinders wherever possible.

120 NOPAK ¾", 4-way, all bronze, 250 lb. type valves, panel-mounted . . . "fed" and exhausted through manifolds . . . actuate the double acting cylinders which open and close the *intake and drain gates* for filtration and backwash operations.

Five NOPAK Valves are mounted at each of the 24 table control stations. There are 12 stations in each of the two filter galleries, and one operator normally takes care of all 24 stations.

For Technical Data on NOPAK Valves and Cylinders, refer to Sweet's File for Product Designers, or write for Bulletin SW-1.

GALLAND-HENNING MFG. CO.
2759 S. 31st Street • Milwaukee 46, Wisconsin

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

A 7095-½H

ONE UNIT **FILTERS AND LUBRICATES** COMPRESSED AIR

COMBINATION { FILTER LUBRICATOR

ENTIRE OPERATION IS VISIBLE!

You can't beat this for efficiency. The single, compact unit filters the air and disperses the correct amount of atomized oil. Transparent bowl enables you to see when new oil supply is needed and when glove needs replacement. Made in pipe sizes from ¼" to ¾". The CCA Filter-Lubricator can be installed in an air line with two simple pipe connections. Limited quantities shipped from stock.

Write for catalog

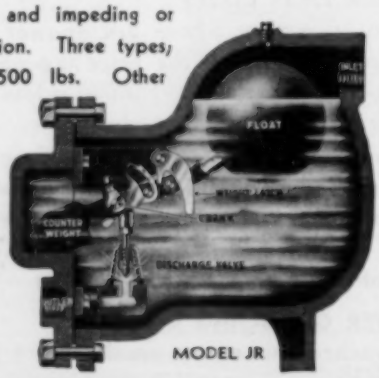
CCA Products Division
BRECO MANUFACTURING COMPANY
309 East Saratoga St., Baltimore 2, Maryland
Dealer franchises available in certain territories. Write or wire Sales Manager.

New **NICHOLSON**

NON-PLUG AIR TRAPS

Introduce Oil-Eliminating Feature Preventing Build-up of Scum and Sludge

In these Nicholson air traps you enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Three types; pressures to 1500 lbs. Other features: No air - wasting vent. Positive water seal at valve. Large orifice keeps valve clean. For details send for . . .



MODEL JR

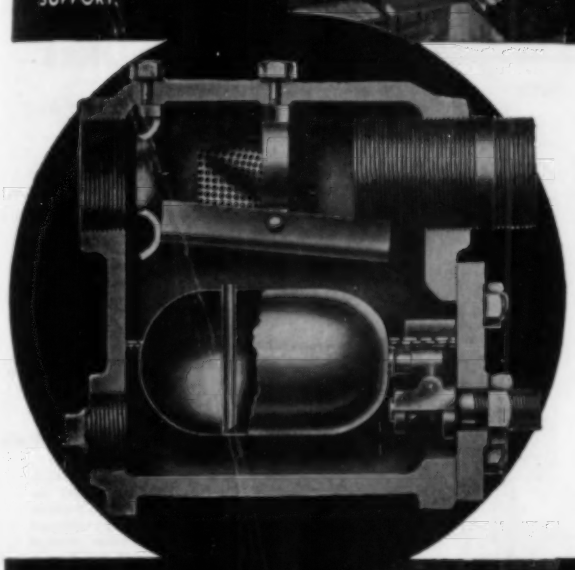
Bulletin 651

180 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

POSITIVE ACTION

SPRING CHECK VALVES

NON-LEAKING

NOISELESS-LONG LIFE

POKORNEY BRONZE Spring Check Valves "Series 1000" meet the need for positive dependable service on air compressors, gas pumps, water, air, oil or gas lines, including Butane and Propane.

This piston operated, spring loaded, screw cap valve has a special Silicone rubber seat which withstands temperatures up to 500° F, on intermittent service, is resistant to oil, grease and most chemicals. Special discs available for higher pressure water, steam, or air lines. All are easily renewable and give quiet, non-sticking, leak proof operation.

Each valve individually tested and guaranteed for long efficient service at 150 lbs. steam pressure, or 300 lbs. W.O.G. Available in 7 screwed I.P.S. sizes from 1/8" to 1¼". Write today for complete specifications.

Serving Industry for Over 45 Years.

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Any Combination at Proportionate Savings

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Cameron Hydraulic Data	3.00
Cameron Pump Operators' Data	2.00

COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey. Please send me:

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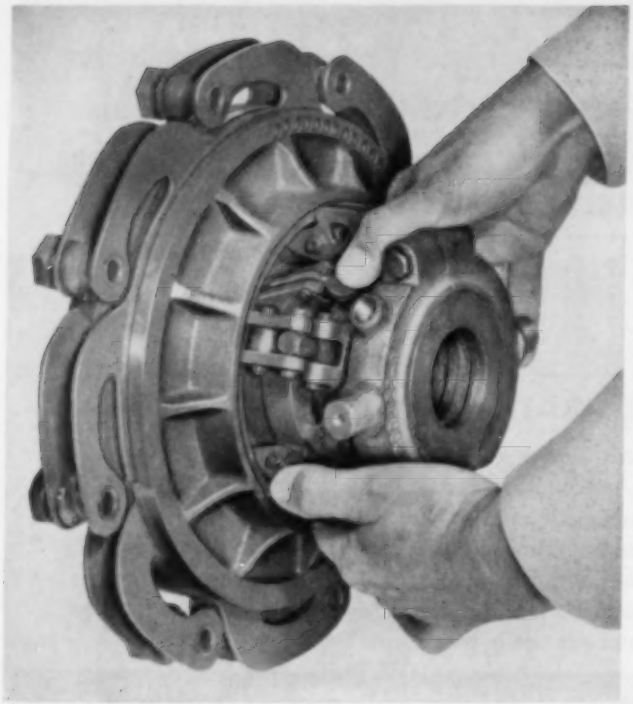
- ☐ Compressed Air Data and Cameron Hydraulic Data .. Both books for $5.00
- ☐ Cameron Hydraulic Data and Cameron Pump Operators' Data Both books for $4.50.
- ☐ Compressed Air Data and Cameron Pump Operators' Data Both books for $4.50.
- ☐ Enclosed is (money order) (check) for $.....) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name .....

Company .....

Street No. .....

City ..... State ..... County .....



Over-center Double Flex-Disc, showing method of adjusting for wear by releasing thumb latch and turning toggle assembly.

The Over-Center *Flex-Disc
A Quality Industrial Clutch

Low power losses, low maintenance costs, and a long, dependable service life characterize our Over-center *Flex-Disc* and Solid Disc friction clutches. These heavy duty, general purpose industrial clutches range in size from 275 to 19060 lbs.-ft. torque.

The history of the *Flex-Disc* type of clutch goes back twelve years, during which time it has been used by Ingersoll-Rand in their portable line of air compressors.

A corresponding Solid Disc Clutch with bolted up disc in two halves for easy removal is also available.

Our twenty years of engineering experience in clutch design is at your disposal. Write for bulletin 5003 for further information and specifications on Over-center clutches.

*U. S. Patent Nos. 2,177,362; 2,259,461; 2,303,201 and others pending.

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